Trends in 1959 Car Design p. 25

SAE Journal

DECEMBER 1958

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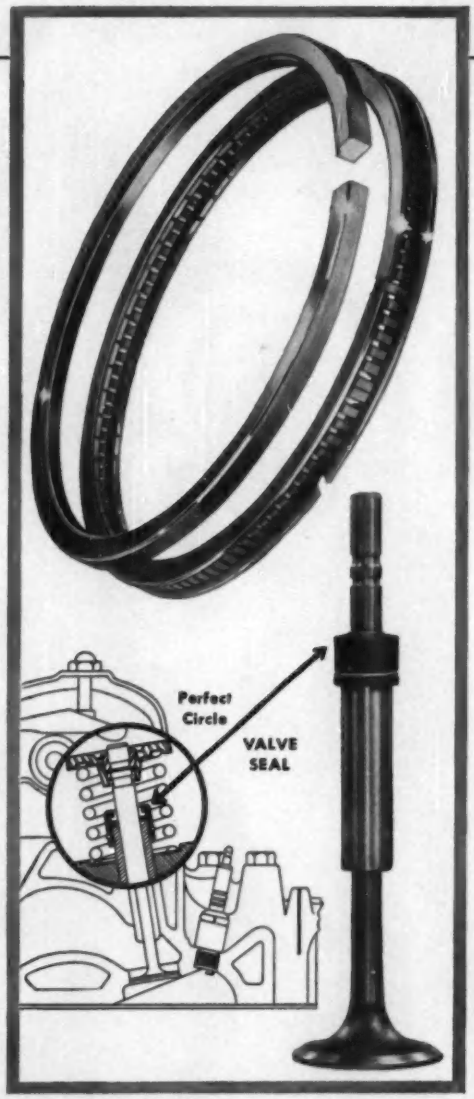

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Many of the engineering changes in the 1959 passenger cars . . . changes in suspensions, drive lines, brakes, and steering . . . were made chiefly to accommodate a bumper crop of new lower and wider bodies. And these announcement changes appear this year against a backdrop of rumors about smaller cars, aluminum engines, unitized bodies, and rear-axle transmissions. — **Walter G. Patton**

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Industry's Role in Defense Is Changing 42

The time has come when some mental gear-shifting is in order to line our ideas up with the new pattern of defense participation that has been developing in recent years . . . underlying industry's changing role are certain trends that have been developing in military aeronautics. — **J. L. Atwood**

New UGL Test OK'd for Army Spec 46

More severe test developed by CRC to measure antiscoring properties of universal gear lubricants has been made a part of a proposed revision of Military Specification MIL-L-2105. Its use should assure adequate antiscoring protection for rear axles under present-day driving conditions. (CRC-330)

Corrugated Suppressor Reduces DC-8 Noise 49

A corrugated suppressor followed by an ejector equipped with a target-type thrust brake supplies 9–12-db noise suppression and better than 40% reverse thrust in Douglas' new DC-8 jet transport. (Paper No. 85A) — **L. R. Jordan and C. M. Auble**

Ceramics Are Aiding Nuclear Power Field 53

Use of ceramics in a process now being developed to provide safe disposal of radioactive wastes is just one of the ways in which ceramics are aiding the nuclear power field. — **C. W. Phillips**

"Hot Shot" Wind Tunnel Uses Arc Heating 54

Arc-heating is Lockheed's answer to a hypersonic tunnel for Mach 15–25. The tunnel reaches these Mach numbers and does it with true stagnation temperatures. (Paper No. 84A) — **Ronald Smelt and T. E. Turner**

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Use of fiber glass reinforced plastic as a material for making truck cabs has many advantages. For one thing, it is light in weight, so that more payload can be carried. (Paper No. 100A) — **B. C. Harris**

Air Conditioning the Lockheed Electra 58

Passengers on the Lockheed Electra will be cooled comfortably and quietly by a single air supply duct and warmed by radiant panels in the sidewalls. (Paper No. 87C) — **J. G. Krisilas and E. S. McCarthy**

Three Speed Ranges for VTOL Aircraft 62

Three speed ranges offer the most promise for VTOL aircraft if thrust requirements for cruise and take-off are to match. The ranges are centered around Mach numbers of 0.65, 0.8, and 2.0. Here there is a chance to overcome the high thrust needed for hovering by use of bypass augmentation, special hovering jets, or favorable ground effects. (Paper No. 95C) — **W. Z. Stepniewski**

Boeing 707 Fuel System Design 63

Simplicity, reliability, and safety were the objectives sought in designing the fuel system of the Boeing 707. (Paper No. 89B) — **E. J. Osols**

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Multifuel Engines Have Proved Themselves 70

Multifuel piston engines have already proved themselves practical for future production. Both foreign and domestic developments meet the basic requirements for fuel tolerance. Techniques for temperature control have been devised which give broad coverage. (SP-158) — See box on page 71

Charles Franklin Kettering 72

Charles Franklin Kettering, president of SAE in 1918, died at his home in Dayton on November 25.

Lockheed Has a Mechanical Loading System ... 74

Lockheed lightning loading system speeds handling of cargo to capitalize on potential of modern airfreighters. (Paper No. 86C) — **E. W. Fuller and R. F. Stoessel**

What Radiation Does to Aircraft Lubricants ... 77

Radiation can produce almost instantaneous failure of modern aircraft lubricants, tests at Southwest Research Institute show. Two types of failures demonstrated are rapid viscosity rise and loss of heat conductivity. (Paper No. 92D) — **John M. Clark, Jr. and George C. Lawrason**

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Lighter, faster, and stronger is the keynote of the vehicles demonstrated to 500 SAE members and guests attending the Ordnance Show at Aberdeen Proving Ground. A full day of the SAE National Transportation and Diesel Engine Meetings, October 20–24 at Baltimore, was set aside for the ordnance demonstration.

Fuels & Lubricants Meeting Reported 84

A thorough airing of the increasingly complex "vapor lock" problem was a highlight of the SAE National Fuels & Lubricants Meeting, held at Tulsa, Okla., on November 5 and 6. At a standing-room-only session both passenger car and petroleum engineers presented their latest thinking on this controversial subject.

Airborne Electronic Component Failures 88

Two avenues are open to the designer to reduce airborne electronic part failures due to vibration. He can use standard equipment and isolate it against vibration or he can make the part more rugged. The choice depends largely on the type of aircraft (or missile) and the local vibration level. (Paper No. 83D) — **Carl A. Golueke**

1965 Fluid Power Problems 99

What problems will the hydraulics engineer of 1965 face? Number ONE looks like finding the power to drive his equipment. Following close will be the new high-altitude effects plus all the present-day requirements with which he must deal. — **Sorro Prete**

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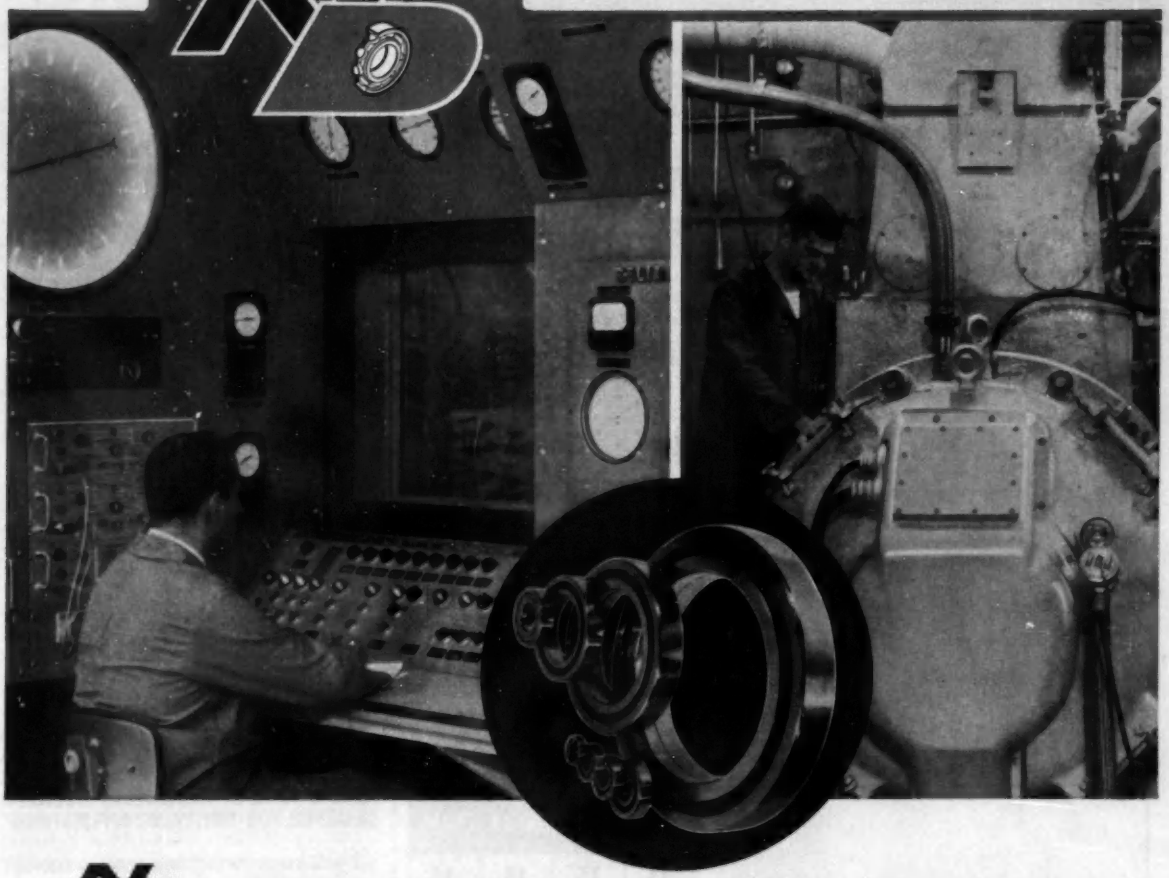

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AIRCRAFT

Practical Design Suggestions for Users of Brazed Honeycomb Sandwich, F. F. RECHLIN. Paper No. 82C presented Sept.–Oct. 1958 16 p. Interdependent region between design and process conditions in which brazing process may dictate or influence designer's choice of configuration or material; methods for taking design advantage of inherent characteristics of process; illustrated design suggestions.

Dynamic Effects on Airborne Electronics, C. A. GOLUEKE. Paper No. 83D presented Sept.–Oct. 1958, 10 p. Some specific vibration levels that general airborne electronics and component parts will withstand without benefit of vibration isolators; applicability and function of isolators; substantial vibratory forces over period of time create serious troubles within electronics.

Method of Equating Long Duration-Low Intensity and Short Duration-High Intensity Random Vibration, A. J. CURTIS. Paper No. 83C presented Sept.–Oct. 1958, 5 p. Method, developed by Hughes Aircraft Co., of determining equivalence between long duration low intensity and short duration high intensity vibration on basis of fatigue damage; it is felt that intelligent application of method will yield useful results.

Lockheed Arc-Heated Hypersonic Tunnel, R. SMELT, T. E. TURNER. Paper No. 84A presented Sept.–Oct. 1958, 19 p. Facility at Palo Alto Research Laboratories of Lockheed Missile Systems Div., designed to investigate problems associated with heating and stability during re-entry from ICBM trajectory or satellite orbit; Hot-Shot Facility supplies power to "low speed" blowdown tunnel with Mach number range from 10 to 24, and high speed shock tube facility for range above 100; advantages of arc heated and shock tube wind tunnels, compared.

Design Considerations for Intermittent Wind Tunnels, D. P. CUMMING. Paper No. S110 presented Mar. 1958 (San Diego Sec) 12 p. Design problems arising from storage and release of large quantities of h-p air and short running intervals; process of air storage and release, methods of air reheating in use, and run time limitations; factors to consider in typical installation for aerodynamic testing of aircraft and missiles; types of support systems; specific wind tunnel operation and use.

Convair's New Trisonic Wind Tunnel, W. T. MacCARTHY. Paper No. 84B presented Sept.–Oct. 1958 13 p. High speed pressure blowdown tunnel with sections for transonic and supersonic testing; dry compressed air is stored in six cylindrical tanks with total volume of 28,000 cu ft at 600 psia; details of air system, control valve, diffuser and settling chamber, nozzle, and variable diffuser; sound control.

Wind Tunnels and Their Extension into Future, J. T. KENNEY, P. V. H. SERRELL, Y. N. YU. Paper No. 84C presented Sept.–Oct. 1958, 8 p. For purpose of discussion wind tunnels are divided into subsonic, near sonic, transonic, supersonic, hypersonic, and ultra hypersonic; from class to class, differences are in methods of flow generation and speed control; in all cases objective

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is to produce uniform, parallel flow of low turbulence with constant static pressure throughout test region; techniques developed for various designs.

Keeping Jet Transports Working, R. D. KELLY. Paper No. 86A presented Sept.–Oct. 1958, 10 p. Economic success depends upon proper scheduling and usage so that high order of productivity is achieved; effect of payload, speed and utilization are factors which cause drastic variations in overall transportation output of aircraft; it is shown how these three factors combined, influence ability of aircraft to achieve maximum productive capability.

Design of Commercial Jet Aircraft for Specific Routes, M. L. PENNELL. Paper No. 86B presented Sept.–Oct. 1958, 9 p. Approach taken by Boeing Airplane Co., in development of aircraft in intercontinental, transcontinental and intermediate range; need for lowest possible operating costs demonstrated by ATA data on total income and expenses of domestic trunk carriers since 1938; influence of size on operating costs and seat mile costs; effects of airplane variations on airlines and manufacturers; feasibility of small airplane designated Model 727 to meet future needs.

FUELS & LUBRICANTS

New Engine Laboratory for California Research Corporation, B. W. MOORE, W. E. VERNON, J. A. BERT. Paper No. 72D presented Aug. 1958, 9 p. Building houses industrial lubricants testing and fuel bench laboratory, engine wind containing 14 test cells, 10 dynamometer stands, and 4 single-cylinder test rooms; blending facilities and distribution system; method of handling laboratory test fuel requirements.

GROUND VEHICLES

Multifuel Engine Symposium. SP No. 158, 41 p. Multifuel Engines for Ordnance, E. F. BLACKBURNE, R. H. SAWYER, 7 p; Multifuel Experience with GM Model 71 Engines, E. J. GODLEW, H. S. FORD, Jr., 3 p; Multifuel Engine Experiences, H. H. HAAS, 4 p; Multifuel Operation in Diesel Engine, W. LENZI, 6 p; Preliminary Tests with Various Fuels, B. LOEFFLER, 9 p; Industrial Type Multifuel Engines, A. LURKEN, 12 p.

Trends in Hydraulic Systems, P. C. MORTENSON. Paper No. 78A presented Sept. 1958, 14 p. Trends in pumps for agricultural and mobile hydraulic systems with respect to performance, costs, and capacities; reference to power steering pump with integral flow control valve, built by Vickers, Inc; characteristics of hydrostatic drive transmissions; it is concluded that future off highway vehicle will incorporate all hydraulic steering system.

Steering and Traction Characteristics of Rubber-Tired and Crawler Vehicles, W. J. ADAMS, Jr. Paper No. 79A presented Sept. 1958, 13 p. Research study undertaken to compare characteristics of 4-wheel drive off-the-road vehicles of various steering and drive systems with conventional 2-wheel drive and crawler vehicles; research vehicle and tests; it is found that skid steered wheeled and crawler vehicles demonstrated their basic superiority to turn in less space than geometrically steered 4- and 2-wheeled vehicles.

Potential of Unconventional Powerplants for Vehicle Propulsion, P. KYROPOULOS. Paper No. 71A presented Aug. 1958, 21 p. For purpose of discussion commercial vehicles are considered using diesel engine as basis for comparison; limitations of solar, nuclear, and steam power plants, electric drive, motors and generators; comparison of three types of hydrocarbon fueled air breathing engines most suitable for vehicles: captive piston, (diesel and spark ignition engine and their modifications), free piston, and regenerative gas turbine; predictions for future.

Forward Look on Engines, D. T. MARKS, N. M. REINERS. Paper No. 71B presented Aug. 1958, 6 p. Approach taken by Cummins Engine Co.;

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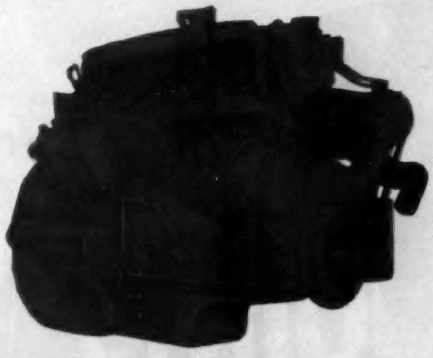

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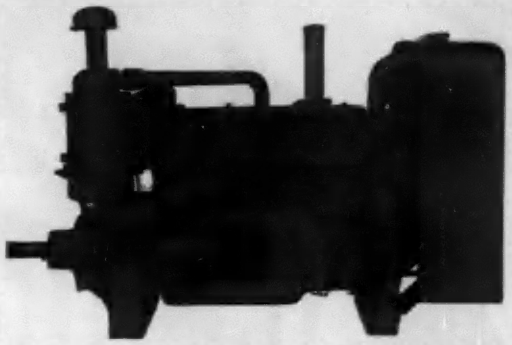

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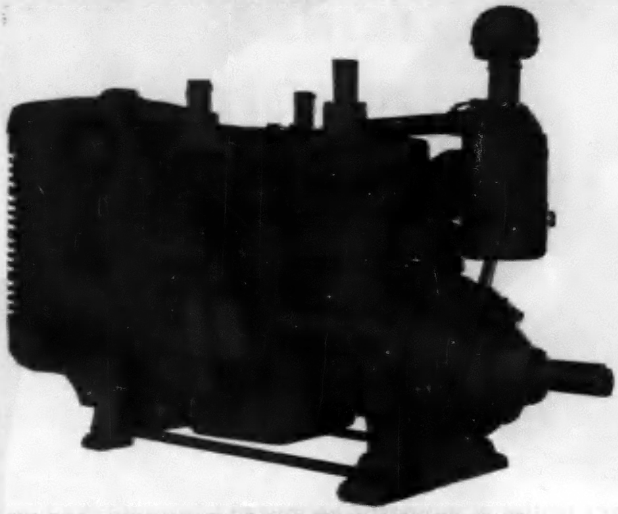

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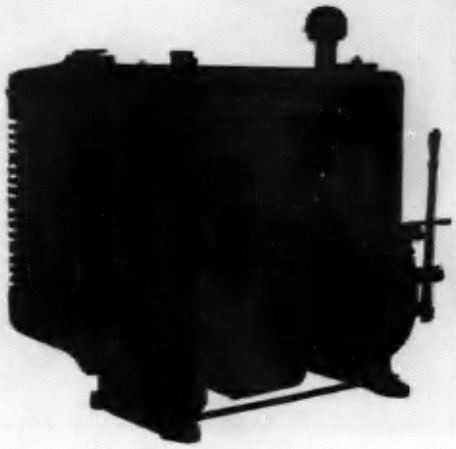

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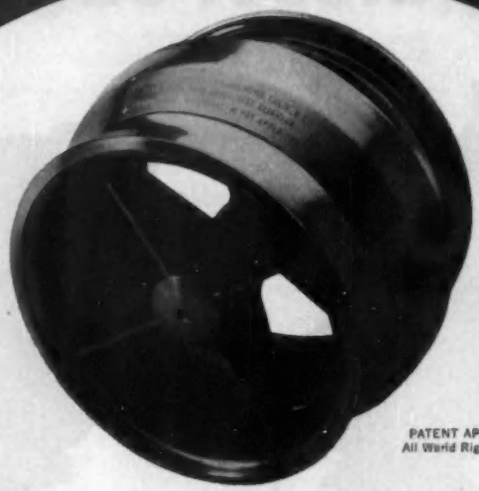

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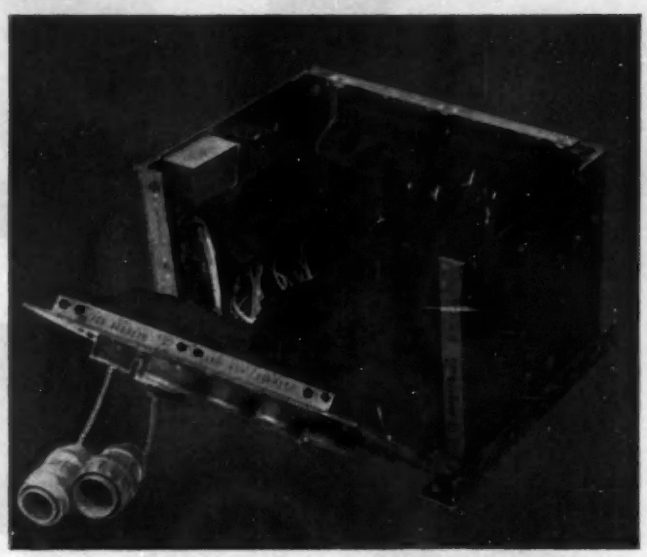
The MATERIAL:

SILASTIC

In the Snark, panels containing resistors, capacitors, transistors and other electronic components are cushioned by Silastic*, the Dow Corning silicone rubber. Silastic protects against moisture, vibration damage, electrical leakage.

*T.M. REG. U.S. PAT. OFF.



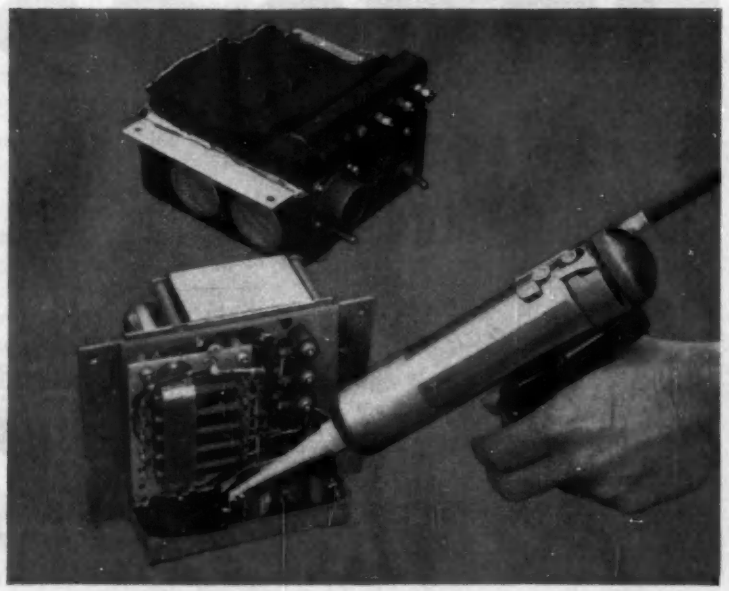
The METHOD:

Encapsulating with Silastic RTV, via calking gun. Silastic RTV vulcanizes completely at room temperature. When vulcanized, it has the characteristics typical of Silastic: resistance to extreme temperatures, moisture, ozone, corona. Electrical properties are excellent. Silastic RTV can be slit open for repair work and then re-sealed. Write for sample and technical data.

Address Dept. 9112

first in silicones

Dow Corning
CORPORATION
MIDLAND, MICHIGAN



how much Dust can a filter collect?

UP TO 99.99%

if it uses WESTERN FELT!

Such efficiency is possible in a Hersey reverse-jet filter with particle size of 5 microns and a pressure drop of ½ inch of water.

Felt can be used to filter solids from solids, solids from liquids, or solids from gases. It is used effectively in fuel filters, air filters, chemical filters, respirators, or dust collectors.

Microscopic barbs on the live fibers of Felt make felt the ideal filtering medium. These scales collect and hold dust particles. They also encourage "build-up" or caking which actually increases filter efficiency. At the same time, their natural interlocking action holds fibers tightly together, through years of flexing.

For helpful engineering information on filtration felts, write

WESTERN Felt WORKS

Dept. S
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MANUFACTURERS AND CUTTERS OF WOOL FELTS

In every one of Detroit's

FABULOUS 59's

dependable National Oil Seals

Year after year, Detroit achieves the impossible—improving constantly on the best cars in the world.

Year after year, we ride more smoothly, comfortably and quietly in high-performance automobiles of outstanding beauty.

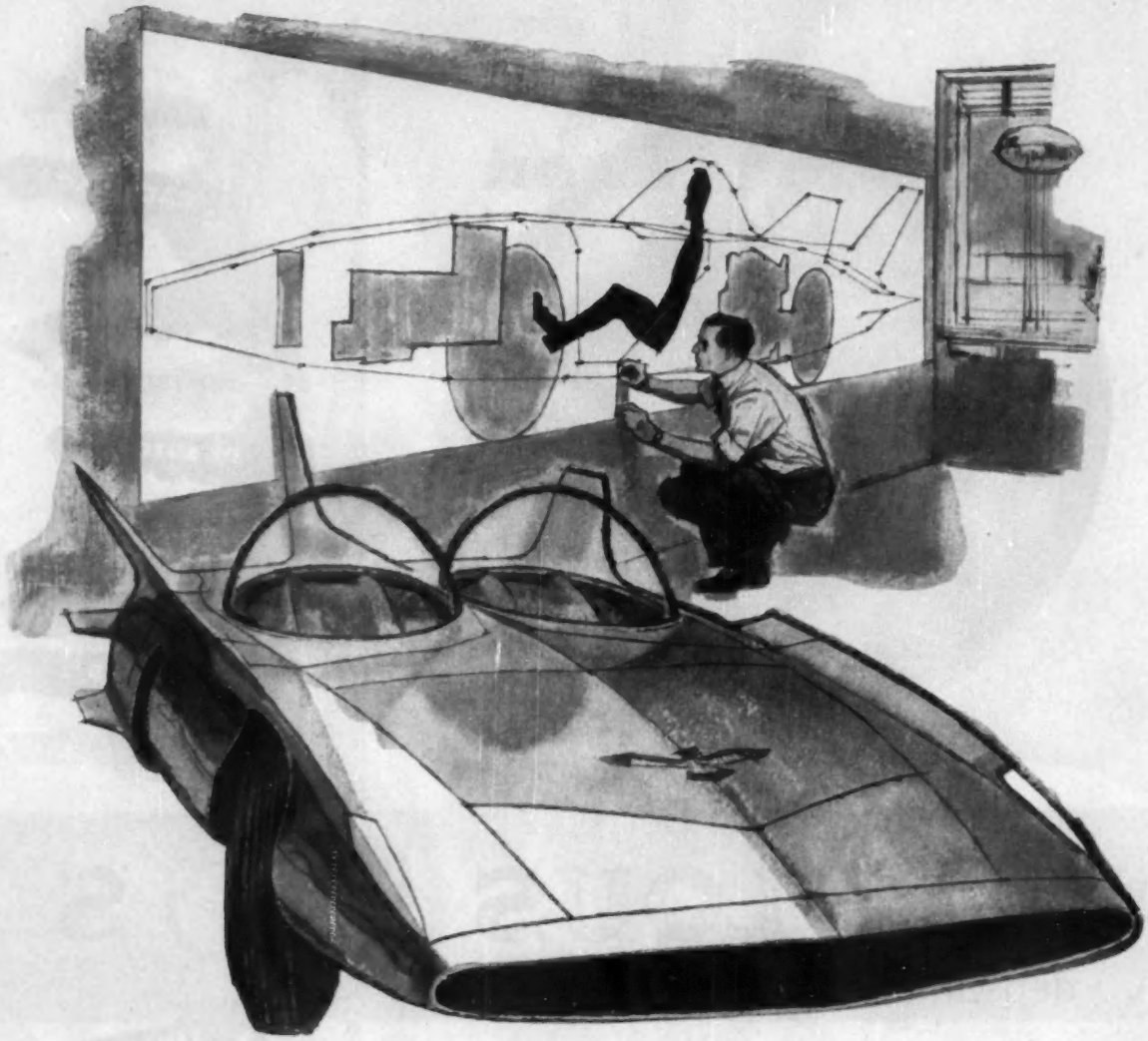
And year after year, Detroit has increased the brute ruggedness and unfailing dependability which have made American cars the world's envy.

Since the dawn of the Automotive Age, National has supplied vital oil seals for the wheels, power trains, engines and accessories of cars, trucks, buses and off-highway vehicles. National is proud of this record, proud to be a part of our nation's greatest industry, proud of the faith Detroit places in the products we make.

Our pledge: still better research and manufacturing to make sure National continues to mean "tomorrow's oil seals—today!"

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Redwood City and Downey, California,
Van Wert, Ohio



Imagination in motion

The motoring public refers to the Firebird as a "dream car." To General Motors it represents an experimental laboratory on wheels. But most important, to the automotive engineer it's a challenge to stretch the imagination in automotive technology.

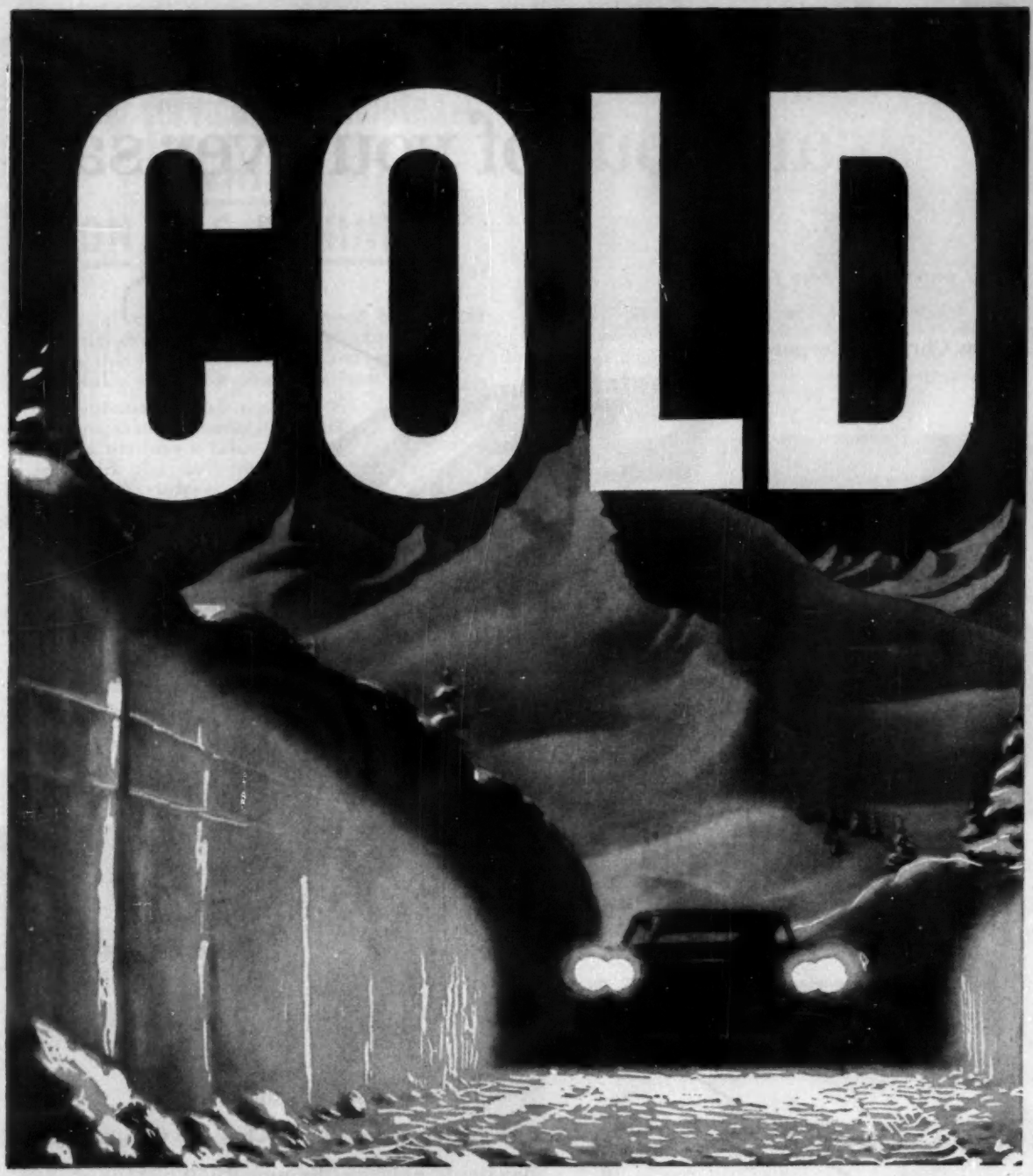
Three Firebirds have been built—each more fabulous than the last. The third "bird" has an automatic guidance system, a unique dual-power system, and Unicontrol—a single lever that starts, stops and steers.

Advancements like these prove that engineers are continuing to meet the challenge of automotive technology. And, through their success, General Motors will continue to fulfill its promise of the future.

GENERAL MOTORS *"More and Better Things for More People"*

CHEVROLET • PONTIAC • OLDSMOBILE • BUICK • CADILLAC—All with Body by Fisher

FRIGIDAIRE • GM DIESEL • ELECTRO-MOTIVE • GM TRUCK & COACH • EUCLID • DELCO • ALLISON



OR HOT... PARATONE-BLENDED OILS DO THE JOB!

Driving conditions—whether in sub zero temperatures—or in blazing summer heat, demand the most from lubricating oils. Oils blended with Enjay Paratone® viscosity index improver remain free flowing all winter long—and provide instant lubrication when starting up. And yet when engine temperatures soar, these same Paratone-blended oils stand up and refuse to thin out.

Enjay has developed the only complete line of high quality additives (Paramins®). To meet the most exacting lubrication specifications, insist on Enjay Paramins.

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Pioneer in Petrochemicals

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Easiest cars to get into and out of you ever saw

Just one of the new features of the 1959 cars of The *Forward* Look from Chrysler Corporation

Swivel Seats turn to let you in and out. Lock in place while you drive. Adjustable up, down, back and forth. Standard or optional equipment on cars of The *Forward* Look.

Another important advancement in automobile design from Chrysler Corporation. Available only on the new 1959 cars of The *Forward* Look. Cars that can do what they look like they can do. A drive will bring out the difference great engineering makes.

PLYMOUTH • DODGE • DE SOTO • CHRYSLER • IMPERIAL

New Holley '59 Carburetors can be serviced in minutes— WHILE ON THE ENGINE!

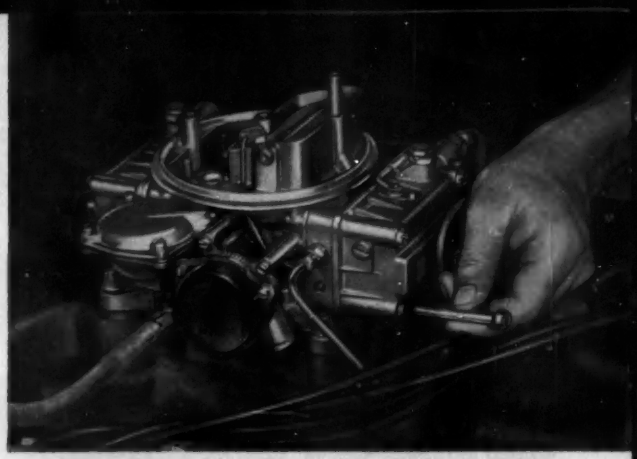
Many 1959 automobiles and trucks will be equipped with newly designed Holley two and four barrel carburetors that have a special needle and seat assembly which makes carburetor service a matter of minutes.

All carburetor minor repair—90% of carburetor service requirements under 30,000 miles—can be completed in the time it takes to remove and replace a single spark plug; and, without removing the carburetor from the engine.

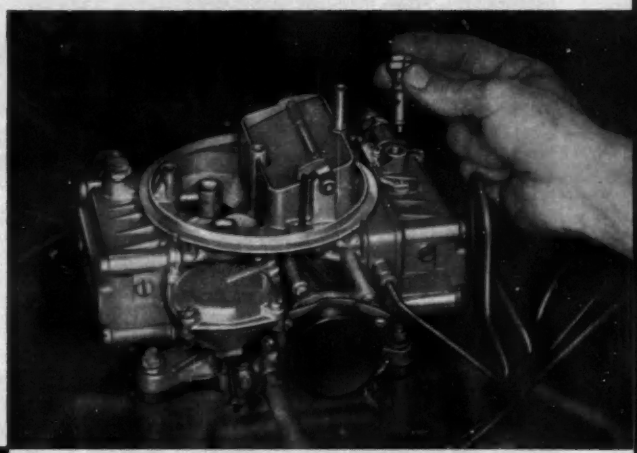
These Holley 1959 models will substantially reduce customer service complaints and will make minor repair work more profitable and more accurate for the service man. With just the four simple steps shown on this page service men can:

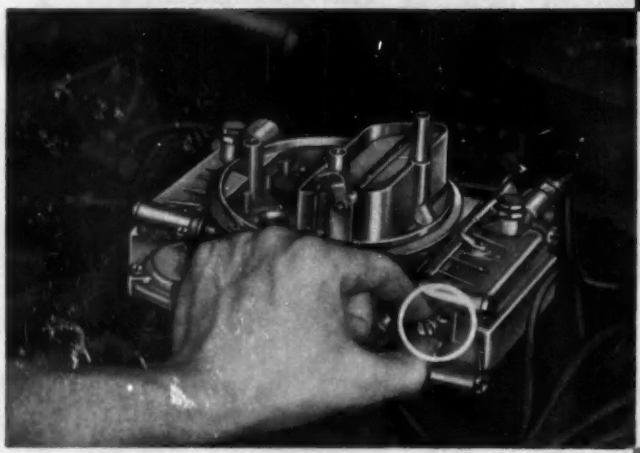
1. Purge the carburetor of dirt and foreign matter.
2. Accurately adjust the fuel level in the bowl.
3. Replace or adjust the fuel inlet needle and seat.

These new 1959 carburetors are another example of Holley's continuing leadership in the design and engineering of fuel and ignition equipment.



1 *With ignition off, remove lower bowl screw farthest from fuel inlet. Allow all gasoline to drain, purging the carburetor of dirt and sludge.*

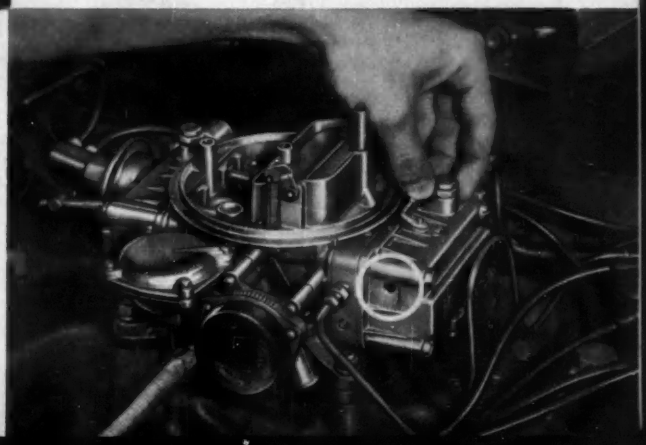




2 *Remove fuel needle and seat and examine for wear and general condition. Replacement can be made at low cost although there should be no evidence of wear until after 20,000 miles.*

3 *With engine running, remove sight plug from carburetor bowl opposite fuel inlet. If fuel level is too high, excessive fuel will drain through sight plug opening. For proper operation, fuel level should be on line with threads at bottom of sight port.*

4 *Loosen top lock nut on needle and seat assembly and adjust with lower nut until float maintains fuel at desired level. Tighten lock nut and minor repair is completed.*



HOLLEY *Carburetor Co.*

For more than half-a-century — original equipment manufacturers for the automotive industry

11955 E. NINE MILE ROAD • WARREN, MICHIGAN

I-29

See the

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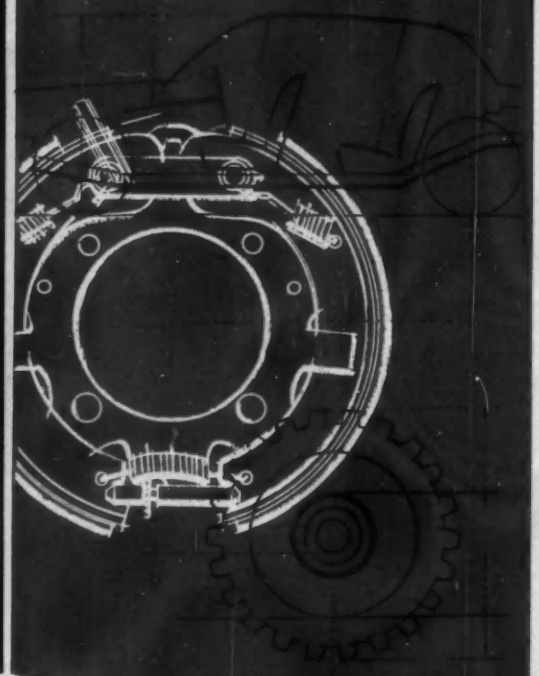
S A E



BENDIX PRODUCTS DIVISION

For a quarter of a century, Bendix Products Division has maintained leadership in important automotive components.

BENDIX-FILTER DIVISION

Bendix-Filter Division, originator of micronic filtration, meets the design needs of the automotive industry with over 350 types of filters.

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Bendix-Eclipse brake linings and blocks are on more new vehicles than any other make of linings and blocks.

LAKESHORE DIVISION

This division manufactures hydraulic valves and cylinders for automotive and agricultural applications. Also producer of grey iron castings.

ECLIPSE MACHINE DIVISION

This division has manufactured over 125 million Bendix® Starter Drives and also the famous Stromberg® Carburetor and the Bendix® Electric Fuel Pump.

BENDIX RADIO DIVISION

Bendix® Radio is deeply engaged in production of all types of radio equipment, but is equally familiar with automotive problems.

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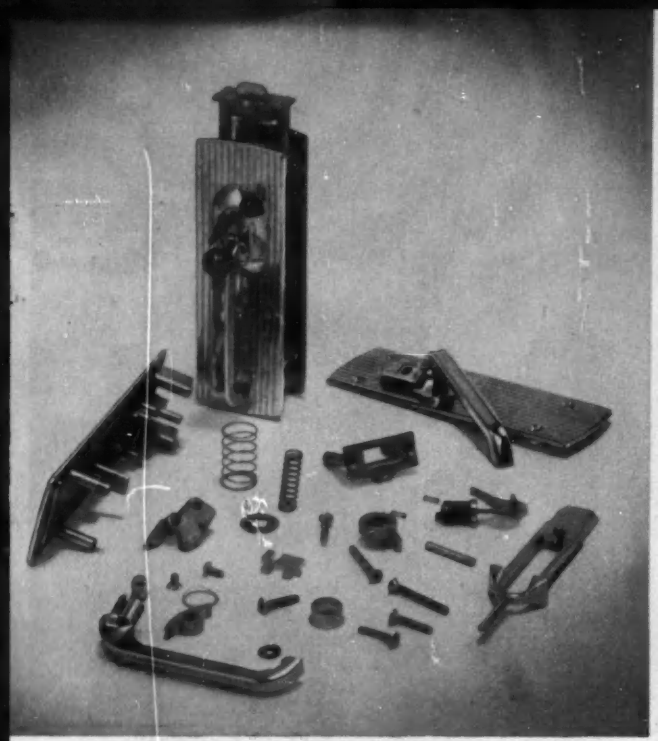
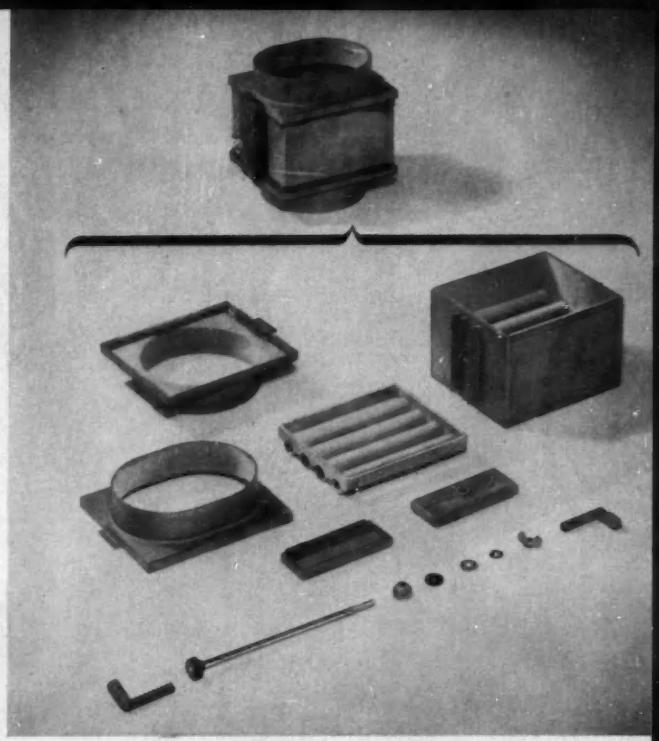
SPACES 37-38-39-40

Bendix

AVIATION CORPORATION



D-J casts, finish machines, plates and assembles door hardware for a Mid-West merchandiser. Eleven zinc parts are die cast . . . then tapped, reamed, faced and plated. Other parts are drawn and stamped as needed. Springs, lock washers, screws, locks and keys are purchased. Finally, D-J assembles and packages the units.

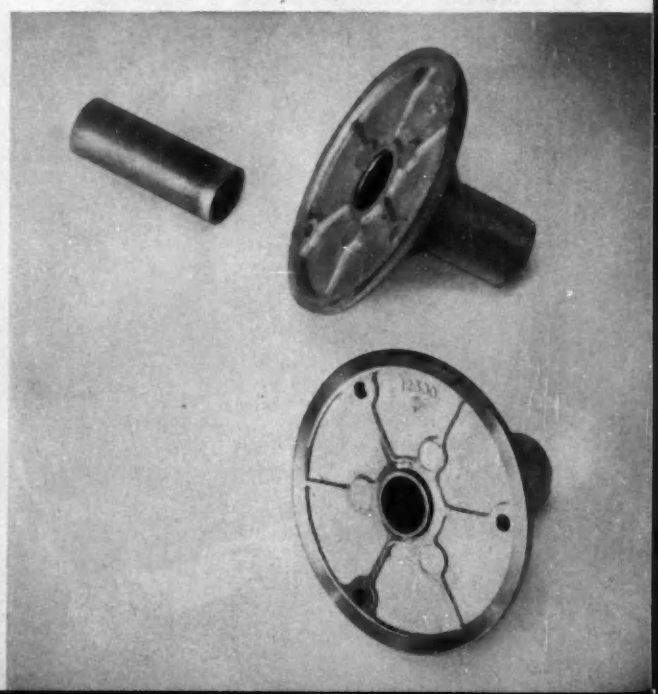


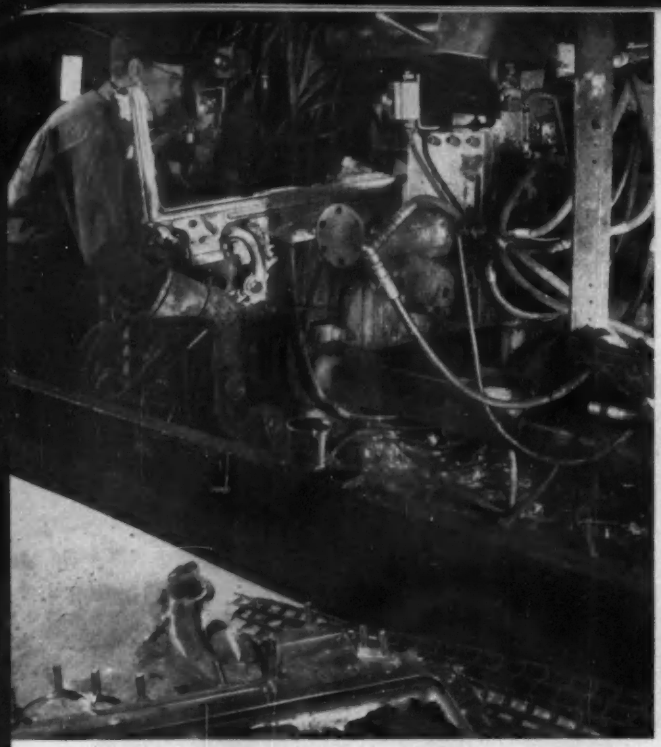
D-J die casts, machines, flock finishes and assembles damper for York Corporation. Unit is a complex high precision assembly of ten die cast parts including racks, pinions, and pistons. D-J flocks interior parts before assembly, seals seams to air-tightness under pressure. Exterior surfaces are carefully alodined.

3 pages of proof Doehler-Jarvis can do more for you than die cast parts...

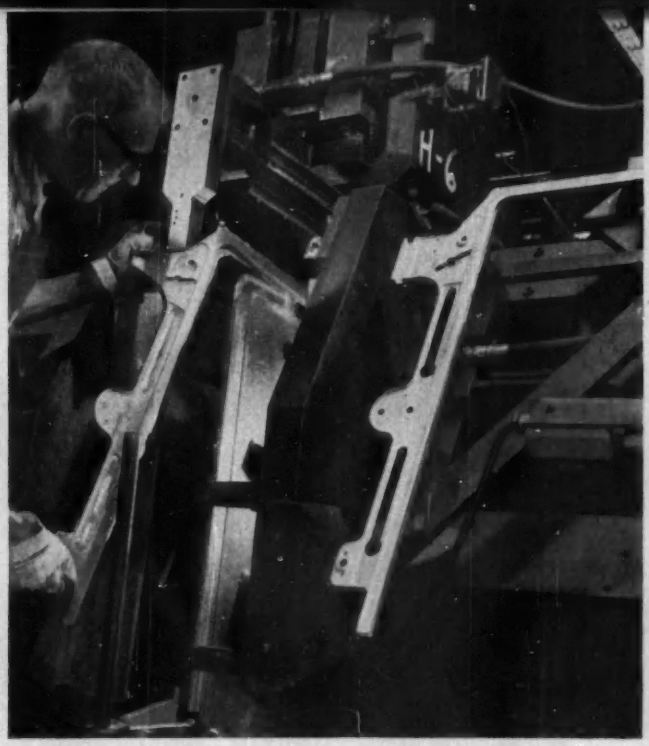
D-J casts, profile shapes, taps and electro-statically paints TV set parts for Radio Corporation of America. Ready-for-assembly die castings are by far the lowest-cost way to produce lightweight metal bezels and glass retainers for RCA Victor TV sets. Their dimensional stability speeds assembly.

D-J casts, machines, and assembles turntable hubs for well-known phonograph manufacturer. Hubs are trimmed, turned, slotted, reamed and fitted with bearings. The bearings are then chamfered and sized. Tolerances of 0.001 inch or less are maintained throughout all these operations.





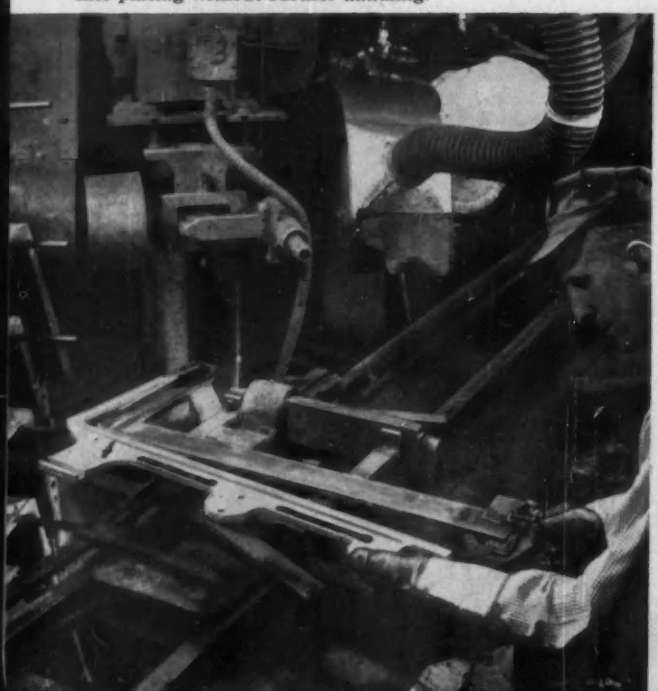
1 **Operator removes die cast zinc main channel** for Lincoln or Continental window assembly from large 48" casting machine. Part is quenched in cooling solution then conveyed to trimming. D-J is now researching production techniques on giant 72" machine, world's largest.



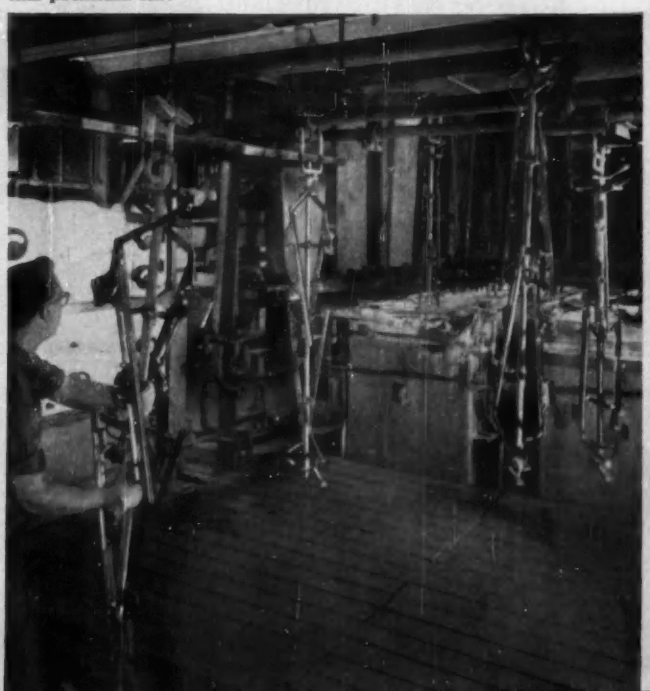
2 **Ingenious double-acting trimmer removes gate,** trims flash, finishes slots, taps 3 holes. Notice jig at right miters corner of frame. Scrap metal is collected, re-melted, re-refined and re-used. Minimum metal consumption is a big advantage of die casting.

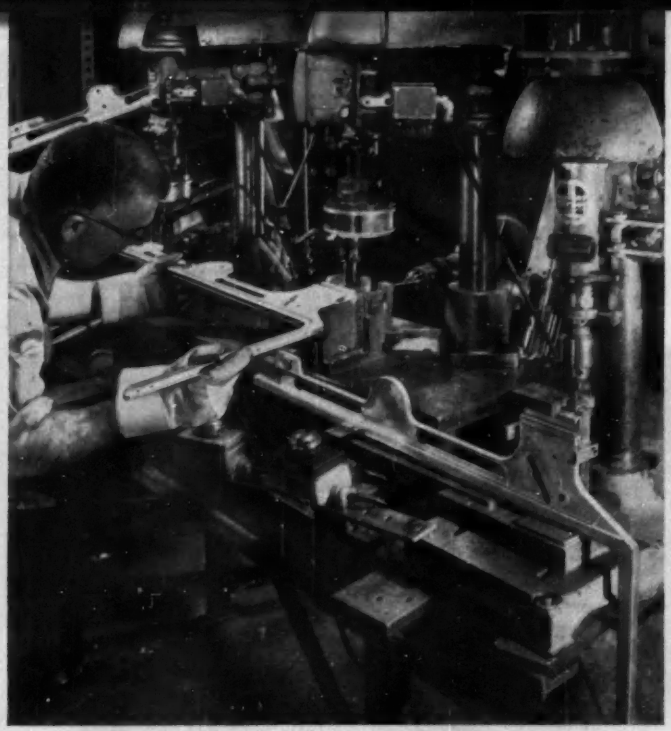
...D-J makes, machines, plates, puts together

4 **Buffing, too, is set up for maximum economy.** Part is snap-clamped to device that positions it automatically for buffing wheels. When leaving fast-moving buffing lines, parts are racked and processed by conveyor through degreasing into plating without further handling.



5 **"Christmas trees" carry channels through plating.** Part is given optimum copper, nickel, chrome thicknesses using an automatic "plate-on-plate-off" current sequence that develops unusually high quality long-lasting finish desired for this premium car.





3 **Ganged machines complete drilling, tapping, reaming.** Behind operator you can see a universal work toting device. Removable pins support work and present it to operator prepositioned for speediest handling. (For another view of device, see following picture.)

a window assembly for the Lincoln Continental

6 **Window is glazed and finish assembled in special jig.** Here die cast channel, glass and other parts (some made, some purchased by D-J) are put together and weather sealed. Packaged part is shipped both to the Lincoln and Continental plants and to distributor warehouses.

Not everyone knows that Doehler-Jarvis does extensive machining, finishing and sub-assembly work as well as die casting.

But it's true. Every Doehler-Jarvis Plant (8 in the U. S. and Barber Die Casting in Canada) mass produces sub-assemblies, as well as die casting and finishing basic parts. And you can rest assured, costs undercut those that customers might achieve in their own plants.

Costs are bound to be low. Doehler-Jarvis has in abundance versatile machining, metal forming and joining equipment plus finishing facilities that are unique. Experienced design, purchasing and production personnel, too. Everything needed to set up economical, continuous production, assembly, and packaging lines.

There are other savings, too . . . savings in *your* plant. Less tooling, for example. And you receive a responsibly inspected, fully functional sub-assembly ready for immediate use. Many D-J customers take delivery only on sub-assemblies needed for basic production. Spare-part production goes directly to customer's distributors.

Makes sense, doesn't it? Especially when you see, as in these three pages of pictures, how D-J handles typical production work.

Maybe you could push your costs down this way, too. Care to talk it over?

Doehler-Jarvis

DIVISION OF NATIONAL LEAD COMPANY

General Offices: Toledo 1, Ohio

In Canada:

Barber Die Casting Co. Limited

Hamilton, Ontario

American Pioneers of Progress

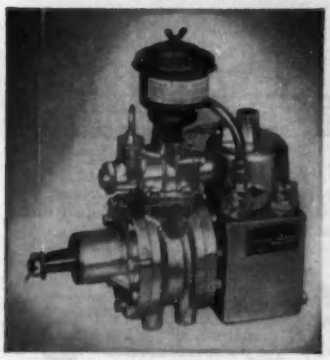
"EVERY ACTION OF OUR LIVES TOUCHES UPON SOME CHORD
THAT WILL VIBRATE IN ETERNITY."

E. H. CHAPIN

CARTER CARBURETOR
DIVISION OF acf INDUSTRIES, INCORPORATED
ST. LOUIS 7, MISSOURI

For the most reliable vehicle air brake systems—

Wagner ROTARY AIR COMPRESSORS



provide ample air...require less maintenance

It is sound judgement to equip the air brake systems of heavy duty vehicles with Wagner Rotary Air Compressors, because Wagner Compressors have the following special features:

HIGH VOLUMETRIC EFFICIENCY Rotary compression forces all air from the compression chambers. Pressure recovery is rapid at all compressor speeds.

LOW TEMPERATURE AIR DELIVERY Oil separation and cooling before air is discharged reduces temperatures and prevents carbon formation. Fire hazard is reduced. Flexible connection may be used in discharge line.

UNIFORM TORQUE LOAD Thousands of small overlapping air compression impulses per minute maintain a more uniform load with moderated stresses and assure smooth, quiet operation with long belt life.

LOW FRICTION LOSS All rotating parts are turned by the rotor shaft, suspended on two bearing surfaces.

HIGH R.P.M. Compressor can be operated at high R.P.M. High reduction drives are unnecessary.

The Wagner Rotary Air Compressor pumps compressed air into the air reservoir, providing the pressure required for the operation of brakes and other air powered devices. The compressor runs continuously while the engine is operating. Pumping is regulated by a control valve which starts or stops air compression by "loading" or "unloading" the compressor proper. This action establishes an intermittent pumping cycle which keeps reservoir pressure within the desired range.

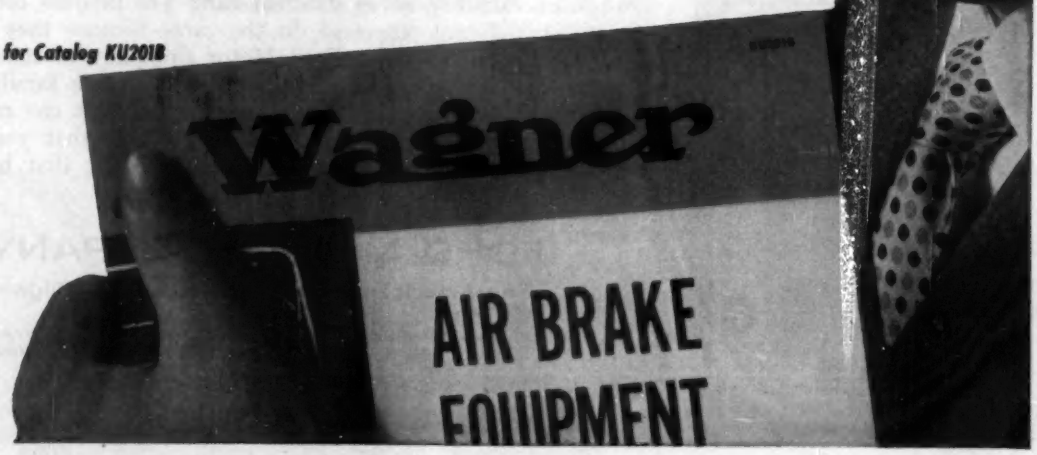
You have a choice. These rotary compressors are available in either 9 C.F.M. capacity, air or water-cooled, or 12 C.F.M. capacity, water-cooled, and are *standard* with every Wagner Air Brake System.

For details on these compressors, Wagner Air Brake Systems and Equipment for trucks, tractors, trailers, buses and off-the-road equipment ... request a copy of Catalog KU201B.

Fleet operators know and trust Wagner

Wagner Electric Corporation
6378 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U.S.A.
(Branches in principal cities in U.S. and in Canada)

ask for Catalog KU201B



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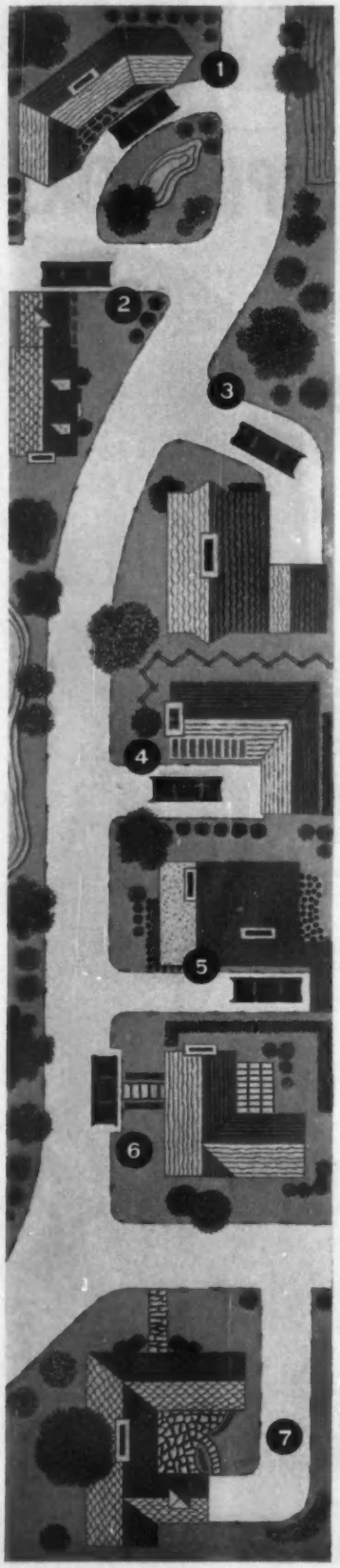
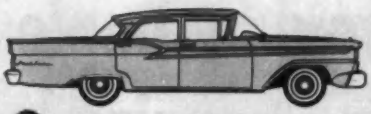
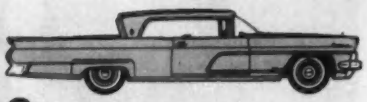


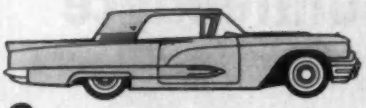
No Conformists on This Street!



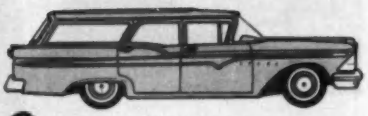
1 It's the Ted Stephens family in their spanking new Ford Fairlane on their way home from Sunday services. *Here's the four-door sedan they drive.*



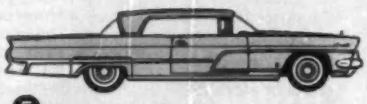
2 Joe Mitchell's new Continental Mark IV gets the once-over by his partner, Cliff Potter, before their weekly golf date. *Picture this in your driveway!*



3 After much pleading, Sue Grant finally wheedled dad's new T-Bird out of him—she's a big-time sorority girl now. *And this new beauty carries four.*

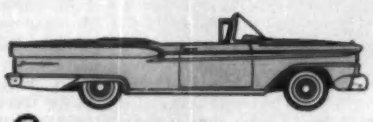


4 That's Ethel and Jack Steele loading their Edsel station wagon for a picnic in the country with the kids. *Here's the nine-passenger, four-door model they chose.*



5 There goes Doctor Summers' new Lincoln Premiere hurrying off to the city hospital. The Elliot baby is on the way! *This is the car his patients recognize.*

6 The new Mercury Park Lane in the Wilson driveway really sparkles—young Jimmy gets a dollar each time he washes it. *Here it is. See what we mean?*



7 Who's missing? The Smiths—June, Fred, Timmy and Tommy. They left early in this Ford convertible for a two-week vacation in the sun.

MORE FEATURES, MORE FUN... IN THE FORD FAMILY OF FINE CARS

Seven families—seven different cars. The families come in seven different sizes—so do the cars—because they were specially designed by Ford Motor Company to meet the needs of these families—and, in fact, all the families of America. That's why we produce 60 different car models with such a variety of styles and features that you can actually select an automobile for your family that has no identical twin on the American road.

FORD MOTOR COMPANY

The American Road • Dearborn, Michigan

FORD • THUNDERBIRD • EDSEL • MERCURY • LINCOLN
CONTINENTAL MARK IV • ENGLISH FORD LINE • GERMAN FORD LINE

For the Sake of Argument

RULES...

RULES ARE OFTEN a lazy man's way to avoid administrative responsibility. He hopes to mechanize office routines which involve person-to-person communication; to eliminate misunderstandings by abolishing the need for understanding.

Faced with explaining carefully a new situation to the involved personnel, he tends to set up a new rule instead. "It takes less time," he rationalizes, "and insures clarity because it's written down ahead of time."

But, others will say:

"Rules get results only when used as the tools of wisdom; never when injected as a substitute. . . . And wisdom is a quality which the administrator must exercise for himself — every day.

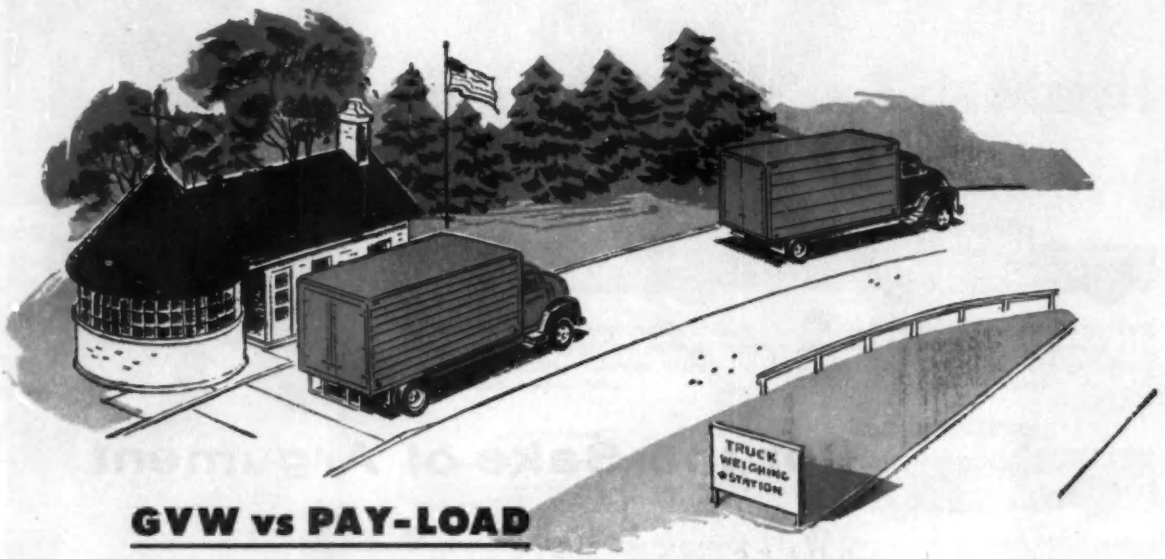
"Rules can only keep things from getting worse; rarely help to make them better. In wisdom there is a dynamic that is lost when codification into rules takes place. A supervisor may make rules wisely, but never can he make rules wise."

Trying to substitute rules for wisdom turns channels into ruts. It clogs with red tape the carefully built canals through which business routines are meant to flow.

Successful administration creates a rule-using group, not a rule-obeying group. And to *use* rules, each individual in the group must be brim-full of understanding . . . understanding of group aims, of management purposes, of his own personal responsibilities. The results achieved by such an understanding group of rule-users will always outstrip those of rule-obeyers.

Over-reliance on rules comes as often from the otiose as from the disciplinarians. But sometimes it's just a hard man's substitute for an understanding heart.

Norman R. Shidle



GVW vs PAY-LOAD

WHERE A POUND SAVED IS A DOLLAR EARNED!

By saving dead weight, vacuum power can add several hundred pounds to pay-load, and earn extra dollars, as ton-miles build up.

In addition there is vital safety in having physical braking instantly available should power fail for any reason.

For these and other important reasons, vacuum power is the overwhelming choice on trucks, and HYDROVAC* leads all other makes combined.

...It will pay you to look into

HYDROVAC (VACUUM HYDRAULIC) POWER BRAKING BY BENDIX

*REG. U.S. PAT. OFF.

Bendix PRODUCTS DIVISION South Bend, IND.

Bendix AVIATION CORPORATION

1959 CAR DESIGN TRENDS

MANY of the engineering changes in the 1959 passenger cars . . . changes in suspensions, drive lines, brakes, and steering . . . were made chiefly to accommodate a bumper crop of new lower and wider bodies. And these announcement changes appear this year against a backdrop of rumors about smaller cars, aluminum engines, unitized bodies, and rear-axle transmissions.

Nevertheless, significant engineering gains have been made during the past year:

- For the first time in many years, the pendulum has swung *toward* economy and *away from* car performance. Several producers reduced engine horsepower ratings. Some brought out new engines with low compression ratios, designed to improve economy. Where horsepower was increased, the move was usually made to adjust to a competitive situation.
- Practically all 1959 cars are lower than last year's models. A few of the new cars, but not all, are longer. One 1959 car is 2 ft shorter than the corresponding 1958 model.
- Several 1959 cars are wider than last year's models — a fact that has already led to salient changes in suspensions and brakes. The move toward wider cars may also go a long way toward a solution to the troublesome problem of improved underhood ventilation and engine accessibility.
- The trend toward pushbutton operation is continuing. More than a dozen accessories operated by pushbuttons are now available.
- Seats got a new look in 1959. Swivel seats, adjustable seats, and reclining seats appear to be the beginning of an interesting new chapter in automobile seating.
- New car finishes that require no waxing for two years or more have made their debut, bringing to successful conclusion a research program started nearly 10 years ago.
- New shock absorbers and steering gears, introduced this year, represent a substantial improvement over earlier designs.
- Exhaust systems got well-deserved attention . . . and the industry now seems well on its way toward the development of a more efficient muffler that will give much longer life.

General Motors has introduced five new passenger-car bodies, marking the first time ALL GM bodies have been changed in a single year. The program was accomplished in the time usually required to retool selected lines.

Walter G. Patton
Engineering Editor, SAE Journal

(Written by request of and with the cooperation of the SAE Passenger Car Activity Committee)

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Engines . . .

. . . have been tailored to bring peak performance within the normal driving range. Reduced compression ratios permit the use of lower priced, standard fuels. Refinements for 1959 include improved carburetion, reduced noise level, and greater economy.

TWO new basic engines will be offered by Buick in 1959, including a 364 cu in. engine and a 401 cu in. engine.

A new spark plug with electrode extended and better engine breathing are features of the new 364 cu in. Buick engine. The block of the 401 cu in. engine has been designed to withstand increased loads. The crankshaft has also been redesigned. Connecting rods are longer and new pistons and piston pins are used in the larger bore.

A number of refinements in Cadillac engines have resulted in smoother operation, a reduction in noise level and vibration, reduced friction, increased performance and economy. Displacement has been increased 6.9% and the axle ratio has been lowered. Compression ratio is 10.5/1.

The Cadillac 390 cu in. engine is new for 1959.

The 1959 Cadillac engines have been tailored to favor stop-and-go driving. Overall economy is said to be improved by 10%. The stroke has been increased ¼ in. To develop high thermal efficiency, a favorable volume-to-area ratio of the combustion chamber has been selected. There is a new intake manifold. Streamlined exhaust valves are used and there are minor changes in the camshaft. Gains in performance have been made at both the low- and high-speed ends of the curve.

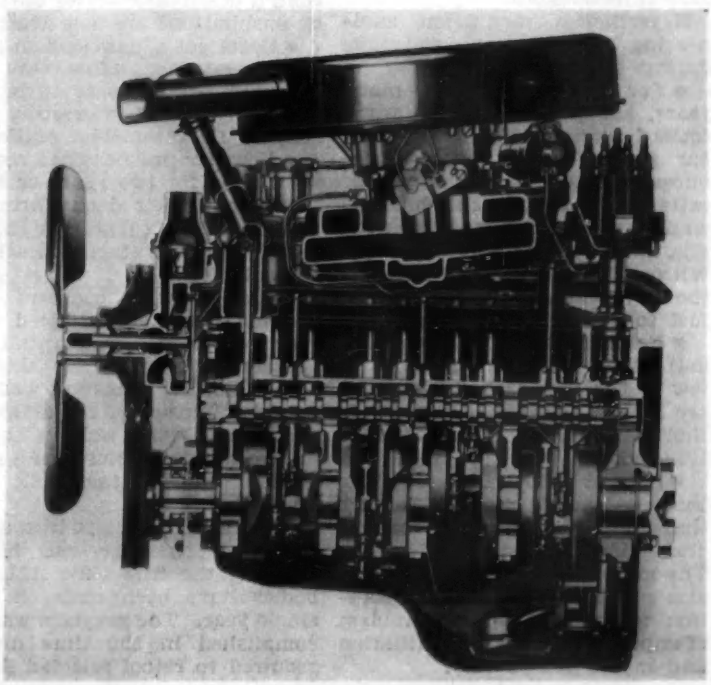
Utilization of a new heat source for the carburetor choke (which is located in the heat cross-over section of the intake manifold) has made it possible to duplicate the heat rise in the manifold; this permits the choke to come off after only a few blocks of driving. A new bimetal compensator valve is used, allowing more air to enter as the temperature of the carburetor increases, thus providing greater stability during hot idle.

Both fuel economy and torque at normal speeds have been improved in the 6-cyl Chevrolet engine as a result of decreased valve lift and a smaller amount of valve overlap. Lower and wider radiator cores have more than 40 additional square inches of frontal area on 6-cyl and V-8 engines. Improvements in the vacuum spark advance system are featured on all basic engines. New dry-type air cleaners and an improved exhaust system are included in the 1959 Chevrolet V-8 engine developments.

All Chrysler and Imperial cars are powered by new engines in 1959. A new in-line valve arrangement permits the use of a single rocker shaft and a lighter cylinder head. Rocker arms are steel stampings.

The new Chrysler engines are 101 lb lighter than the engines they are replacing. Another 18 lb is saved by reducing the cooling system capacity from 25 to 16 qt. The new engines have wedge-shaped combustion chambers and heavy, stiff crankshafts. Accessories are located high on the engine to facilitate serviceability.

DeSoto, Dodge, and Plymouth engines have increased displace-



1959 Cadillac engines have been tailored for stop-and-go driving. This new 390 cu in. engine has been redesigned. Changes include new heads and a new block. These engines show performance gains at both the low-speed and high-speeds ends of the curve.

ments. A new 326 cu in. V-8 is offered in Dodge Coronet models.

Edsel is offering a 292 cu in. economy engine for 1959. Compression ratio is 9/1. The engine operates on regular fuel. Contributing to fuel economy of the 1959 Edsel engines are fuel transfer tubes located in the bottom of the carburetor. This tends to equalize fuel distribution during acceleration and deceleration, minimizing engine surge and carburetor flooding.

Replaceable, dry air cleaners are specified by Edsel this year.

Ford has made a slight reduction in horsepower for 1959. Powerplants have been tailored to give highest engine performance and operating efficiency in the 30–70 mph range. The Ford 6 engine is reported to give up to 20 mpg.

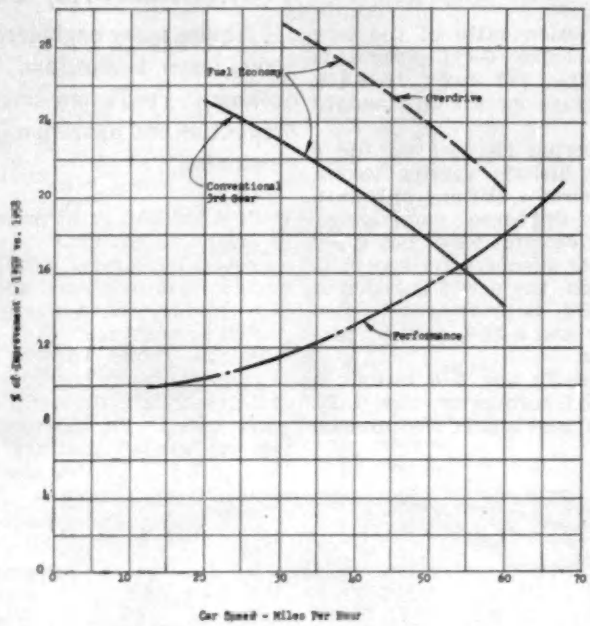
A full-flow filter is standard on all 1959 Ford engines. All V-8 engines have new aluminum-alloy pistons with longer skirts for better oil control. The 2-venturi carburetor on the 292 and 332 cu in. engines is equipped with new jets and venturi. All 1959 Ford engines use a dry replaceable element in the air cleaner.

The 1959 Oldsmobile engines uses "Split Phase" carburetion, in which the choke function has been separated from high idle. In this arrangement, the choke comes off early but high idle continues to function until warmup is accomplished. Passages in the intake manifold have been smoothed out and rod and main bearings are larger.

Compression ratio is 9.75/1 for 1959, compared with 10.0/1 in 1958. Olds is continuing its Econ-O-Way 2-barrel carburetor.

For 1959, Pontiac is offering an optional (with Hydra-Matic transmission) engine designed specifically to give the car owner maximum miles for each fuel dollar. A compression ratio of 8.6/1 was selected so regular gas can be used.

While displacement of this engine is the same as the standard Pontiac V-8 engine (increased to 389 cu in.), refinements have been made to provide optimum economy. These include a 2-barrel carburetor with smaller venturi, redesigned manifold, and camshaft with reduced overlap. The new economy engine develops maximum torque at substantially lower speeds than the standard engine used with Hydra-Matic transmission. Rear-axle ratio used with this engine is 2.87/1.



Studebaker powerplants for 1959 emphasize economy. This series of curves shows the per cent improvement (1959 versus 1958) for the 8-cyl engine.

Crankshaft main bearings of all engines have been increased to 3 in. in diameter. A cast crankshaft will be used in 1959. New Pontiac engine mounts employ the "center of percussion" principle to isolate engine vibration.

The 1959 Rambler 6 is equipped with a new single-throat Holley carburetor. Up to 1½ mpg more fuel economy has been indicated for the new carburetor. Other advantages of the new carburetor design include better hot starts and better stability, particularly under reduced vacuum conditions when the throttle is opened quickly. A new cellulose element carburetor air cleaner replaces a wire gauze type of cleaner. Engine mounts have been made more resilient and a new stabilizing thrust rod is used to absorb secondary fore-and-aft thrust forces.

Refinements made in Lincoln engines for 1959 include improved carburetor and distributor and more efficient engine ventilation. Lincoln is adding a zinc additive to its break-in oil. A magnet has been added to the fuel filter.

Nylon spark-plug lead combs are used on rocker covers to avoid loss of electrical efficiency. Vacuum pump capacity is up 25%.

Carburetor icing is said to be virtually eliminated with the addition of improved hot-cold air intake control. Carburetor air temperatures are reported held in the narrow range of 80–100 F. Vapor lock is minimized by the new system.

Three sizes of engines will be available on 1959 Mercury models; 312, 383, and 430 cu in. A number of refinements have been made in the 1959 engines, including a redesigned oil pan.

The 383 and 430 cu in. engines have a water-heated intake manifold, replacing exhaust heat. Better temperature control of the fuel-air mixture is reported. An important feature of these engines is a 3-stage, parallel-flow cooling system using three thermostats. Thermomatic air intake for carburetion is used.

Studebaker's new 169.6 cu in. L-head 6 develops 90 hp at 4000 rpm. The standard V-8 develops

180 hp at 4500 rpm and 195 hp with 4-barrel carburetor and twin exhausts.

Compression ratio of the new shorter stroke 6-cyl engine is 8.3/1. The V-8 ratio is 8.8/1. Both engines operate on standard fuel.

Engineering changes on the 6 for 1959 include shorter stroke, new carburetor, stiffer crankshaft, and an improved combustion-chamber design. New "hat-type" carburetor silencers are specified. At 35 mph, the new 6 is reported to give 8% improvement in fuel economy and a 20% gain in performance.

Changes in the V-8 include a redesigned carburetor, new inlet manifold, and higher compression ratio.

Transmissions, Controls, and Drive Lines . . .

. . . require many engineering changes to keep pace with today's engines, lower bodies, and the need for improved performance and economy. Ford's new single-range transmission stresses economy of production and operation. The rear pump on Hydra-Matic has been eliminated.

SUBSTANTIAL gains in performance and economy have been achieved by careful matching of engines, transmissions, and axles. The emphasis on economy is expected to continue.

Buick's Triple Turbine Transmission has a new converter pump and new first and second turbine blade forms. For downhill braking, a "grade" position utilizes both the engine and the transmission converter for braking. These new members increase starting and cruising efficiency.

The 1959 front and rear propeller shafts have been redesigned. The front and rear shaft is made up of an 11-in. long bar section welded to the propeller shaft tubing to minimize road load axle noise. The rear propeller shaft has a solid bar connecting the yoke to the splined coupling. This replaces tubing construction used in 1958.

For 1959, Buick is adding an optional positive traction differential. The new differential applies drive to one rear wheel even though the other wheel has no traction.

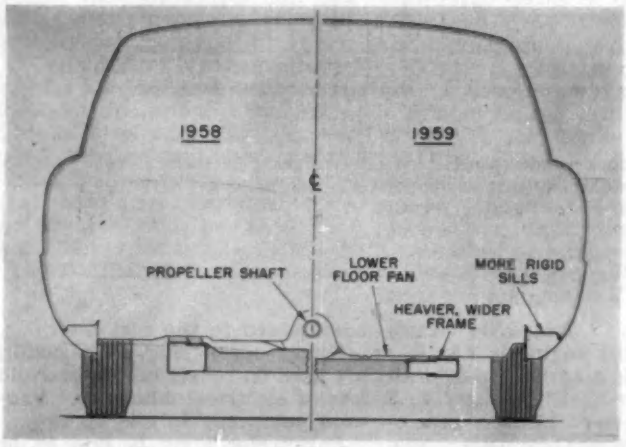
For 1959 Cadillac, along with Oldsmobile and Pontiac, is using a Hydra-Matic with the rear pump eliminated. Buick has also eliminated its rear pump.

This is the first time this step has been taken by U. S. car producers. Removing the rear pump reduces the spin losses, increasing the road load economy; at the same time, it makes it impossible to start the car by pushing.

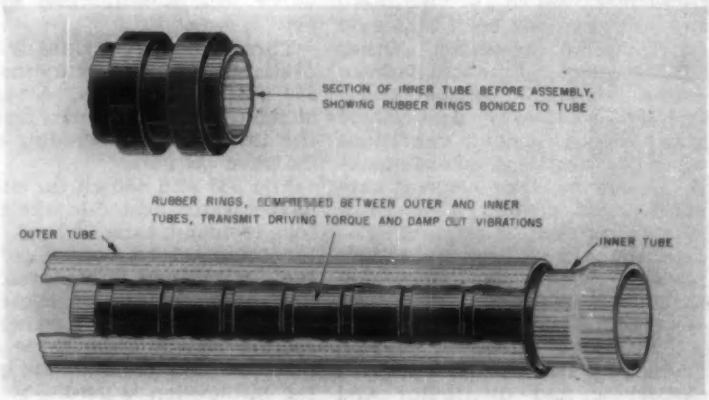
The change was made after a very careful study, by all four divisions. In reaching their final decision, careful consideration was given to these facts: (1) Higher speeds required for push starts in today's transmission makes this operation dangerous, (2) many service trucks, as well as motorists, decline to push another car because of the fear of bumper damage, (3) most stalled cars have to be started by a service car which always carries a slave battery and cables for starting purposes.

A new clutch material has been introduced which provides smooth shifts along with durability. Cadillac, for 1959 is offering two new and lower axle ratios, 2.94/1 and 3.21/1.

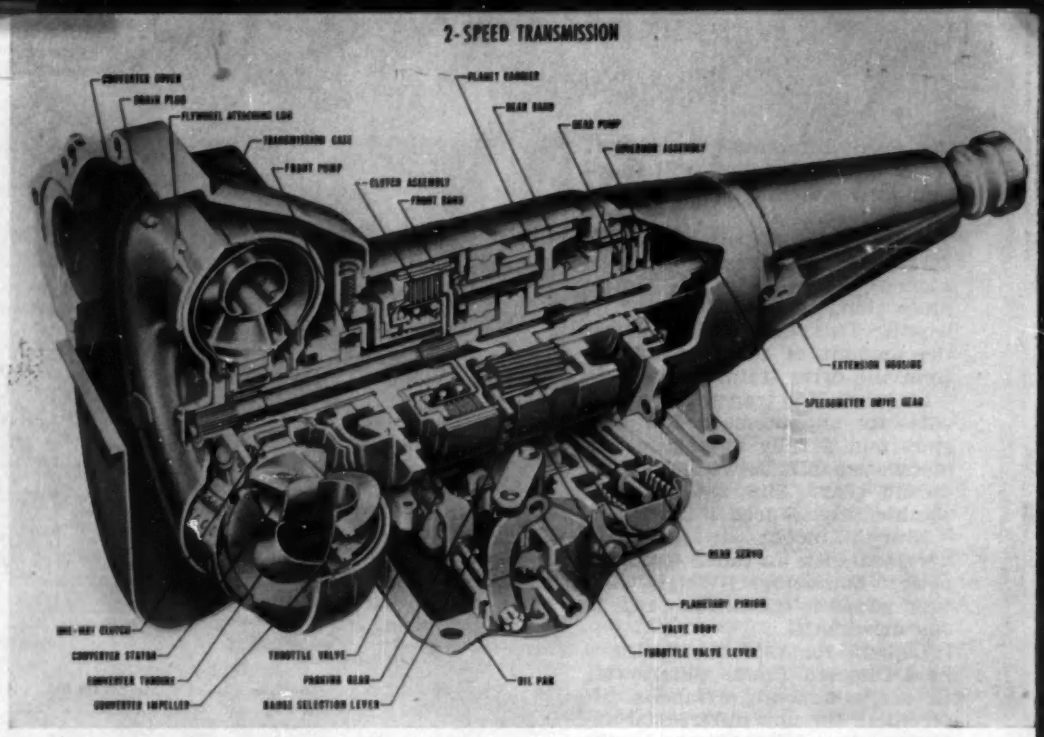
Greater ability to stand up in hard service is claimed for the 1959 Chevrolet transmissions. The



Reduced car height spells trouble for engineers trying to provide ample room under the middle of the rear seat. Shown here is a cross-section through rear floor and frame for the 1958 and 1959 Imperial. A reduction of ½ in. in tunnel height was made possible by the new construction.


SECTION OF INNER TUBE BEFORE ASSEMBLY, SHOWING RUBBER RINGS BONDED TO TUBE
RUBBER RINGS, COMPRESSED BETWEEN OUTER AND INNER TUBES, TRANSMIT DRIVING TORQUE AND DAMP OUT VIBRATIONS
OUTER TUBE
INNER TUBE

Vibrations are damped out and noise is reduced by this unique rubber-cushioning construction for the propeller shaft, devised by Chrysler Imperial engineers.



Ford's new single-range transmission has 105 fewer parts than the 1958 unit and is only 18 lb heavier than the Ford manual transmission. Ford buyers now have a choice of a single-range or a dual-range automatic transmission.

Turboglide has a 5-spoke hub second turbine (previously a 3-spoke design); a new 6-active-face multiple-disc reverse clutch and an 8-active-face, multiple-disc forward clutch. These replace cone designs. The second turbine shaft is increased in minimum section and the hydraulic system has been modified.

TorqueFlite and PowerFlite automatic transmissions are now standard equipment on a greater number of Chrysler models. Increased torque capacity is featured on the TorqueFlite transmission for Chrysler and Imperial models. Water cooling has been extended to Plymouth and Dodge automatic transmissions to improve shifting performance by providing more uniform transmission operating temperatures.

A ½-in. reduction in floor pan tunnel height under the rear seat was made possible by the use of a stepped-diameter propeller shaft that is small in diameter at the rear. This change, applicable to all Chrysler Corp. models except Imperial, provides improved rear seat comfort through increased seat deflection space. This design is also said to provide the stiffness required for high-speed operation.

The Ford and Edsel lines for 1959 are offering two automatic transmissions including a single-range Ford-O-Matic and a dual-range Cruise-O-Matic. The new single-range unit has a 3-element torque converter and a planetary gear set. This light-weight unit has 105 fewer parts than the 1958 unit. The new automatic transmission weighs 50 lb less than the 1958 Ford-O-Matic and is only 18 lb heavier (installed weight difference) than the 1959 Ford manual transmission installation.

The torque converter is a sealed-in assembly. Pump, stator, and rotor are sealed in a welded steel housing. The ratio selector is completely automatic. A 2-stage governor is used.

In drive range at part throttle the transmission upshifts to high at about 16 mph. The 2-speed unit starts in at a lower ratio than the Ford-O-Matic. The manual lever can be operated to shift to low at any speed.

The 1959 Edsel and Ford 2-speed automatic transmission has a 3-element torque converter, coupled to a compound planetary gear set having two sun gears, two sets of pinions, and one internal gear. The planet carrier is the output member of the gear set.

There are two brake bands: the front band holds the front sun gear to provide the reduction in low-speed forward; and the rear band holds the internal gear to provide reduction in reverse.

Two hydraulic pumps are used. The control is provided in one assembly.

With the engine idling and the selector lever in "drive," the new transmission is in "low" gear. Upshift to "high" is made automatically at speeds dictated by throttle opening. As vehicle speed decreases, the unit shifts back to "low" during coasting at approximately 10 mph. There is a forced downshift available for passing. Below 26 mph, a partial throttle downshift is available.

Edsel and Ford also offer a dual-range transmission for greater flexibility of control and higher performance. The dual-range Cruise-O-Matic 3-element torque converter is unchanged.

Ford and Edsel for 1959 are offering a new Ford-designed Equa-Lock differential for positive traction on ice, snow, mud, or loose gravel. The differential is locked except when slipping action is needed, such as in turning a corner. Slippage is permitted whenever rear wheel torque exceeds a pre-set clutch torque of 315–385 ft-lb. An outstanding feature of

the Ford differential is that it "fails safe" — the unit will function conventionally in the event of a failure.

For 1959, the Imperial propeller shaft has a rubber sleeve sandwiched between two concentric tubes along the latter half of its length. This construction reduces the amount of noise emanating from the drive train.

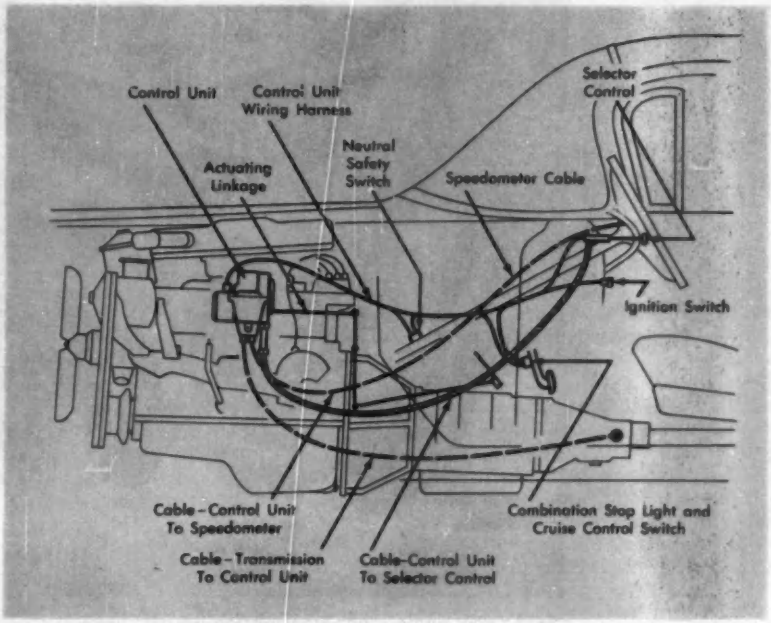
Lincoln's 1959 transmission provides for an automatic low gear start and a fully automatic and modulated shift between first and second gear. Slippage has been significantly reduced, it is claimed.

Every Lincoln driveshaft is provided with an index mark for better balancing. Weight has been added to the extreme rear of the driveshaft.

Lincoln for 1959 is offering a new Directed Power differential. On surfaces having a traction differential, the new differential automatically diverts torque to the wheel having the greatest amount of traction.

Each axle shaft is connected to the differential by a cone clutch, in addition to the usual differential gears. Torque, transmitted from the axle ring gear to the differential case, causes a pin to move up the ramp of a cam surface. This applies load to the cone clutch, which locks the axle shaft to the differential case. When one wheel loses traction, its cone clutch tends to disengage.

Failure of the unit merely eliminates the Directed Power feature and the differential continues to function as a conventional differential.



Optional on the 1959 Cadillac is the cruise control that allows the driver to maintain constant speed without using the accelerator. This unit, built by Perfect Circle Corp., can be quickly overridden by the driver.

Studebaker is offering Twin Traction nonslip differential optional on all models. A Hill Holder is offered optionally on cars not equipped with automatic transmission.

An automatic Cruise Control unit, produced by Perfect Circle Corp., will be offered by Cadillac, as an accessory, in 1959. This device provides automatic throttle control and acts as a speed reminder (SAE Journal, December, 1957, p. 63). The unit links the accelerator and speedometer together to provide automatic, semi-automatic, or conventional throttle control. The driver may override the control by stepping on the accelerator. Application of the brake disengages the device immediately. The unit is designed primarily for use on turnpikes and expressways, where it relieves the driver of the necessity of applying foot pressure to the accelerator during long drives.

Exhaust Systems . . .

. . . have serious corrosion problem. Today's engines require bigger and better exhaust systems . . . and they're getting them.

INCREASING popularity of twin exhaust systems, the use of larger pipes and mufflers to reduce back pressure, and the presence of certain additives in today's fuels and lubricants are all contributing to the growing exhaust system corrosion problem.

One approach to the problem is Chrysler's heavy gage muffler construction. Muffler shells on the 1959 Chrysler are 0.036 in. thick. Chrysler engineers argue that single sheet construction is structurally more rigid than double sheet construction, that this design gives greater freedom from blowouts.

In the 1959 Chrysler mufflers, a layer of asbestos, wrapped around the shell, improves sound-deadening qualities. Heat-retaining ability is thereby increased, it is suggested, and there is less heat transfer to the floor of the car.

Chrysler is using aluminized and zinc-coated steel. Some of the Chrysler-built cars have drain holes in their partitions to permit corrosive liquids to spread over a wide area.

Buick's 1959 exhaust features 2-in. main pipes. The new system has four less hangers and two fewer joints. Mufflers and tailpipes are constructed of aluminum or zinc-plated parts. Mufflers are double-wrap construction.

A new aluminized muffler is standard on all 1959 Fords. Aluminum-coated walls and heads are specified. The inner shell is double-thickness steel. Asbestos wrapping between the inner and

outer casings minimizes condensation and extends muffler life.

Resonators have been eliminated, except on Mercury convertibles. New balljoint connections are used at the manifolds. The exhaust muffler section is larger. Inner shells, ends, baffles and passage tubes are aluminized. The outer wrap is galvanized. Up to 100% increase in muffler life is reported. A heavier gage tailpipe is used. Mercury is using 3-pass construction to hasten warmup and facilitate removal of condensation.

For longer life, Rambler is specifying tailpipes fabricated from welded steel tubing. The tubing is formed from aluminum-coated steel. Tailpipes are installed with the seam at the top so as to minimize rust formation due to condensation. Tailpipe thickness is now up to 0.049 in.

Steering . . .

. . . now reduces manual effort, responds faster, and provides optimum control by the driver. Saginaw Steering Gear Division and Lincoln Motor Division have introduced new power steering gears. Some manual gear ratios have been increased.

RECENT estimates show that 46% of all cars sold in 1958 will be equipped with power steering. This percentage compares with 5.86% in 1952 and 27.75% only two years ago. A manufacturer in the medium-price range reports 85% of all cars sold during the first half of 1958 were equipped with power steering.

Rotary-valve power steering, developed by Saginaw Steering Gear Division, is featured on the 1959 Cadillac, Buick, Oldsmobile, and Pontiac.

The new device has two outstanding advantages: (1) response is much faster than for the 1958 gear and (2) less manual effort is required. Feel-of-the-road steering is retained, however.

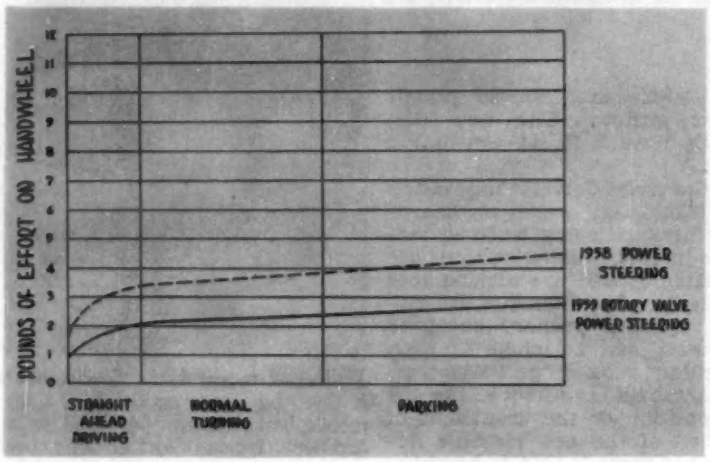
The 1959 power system builds up full pressure by the time the steering wheel has turned 2 deg. This compares with an 8-deg turn for the full response in the 1958 power system. The new system responds with ¼-deg movement of the wheel.

Average driver effort required for parking has been reduced from 4½ to 2½ lb. Less than 1-lb steering effort is needed for down-the-road driving.

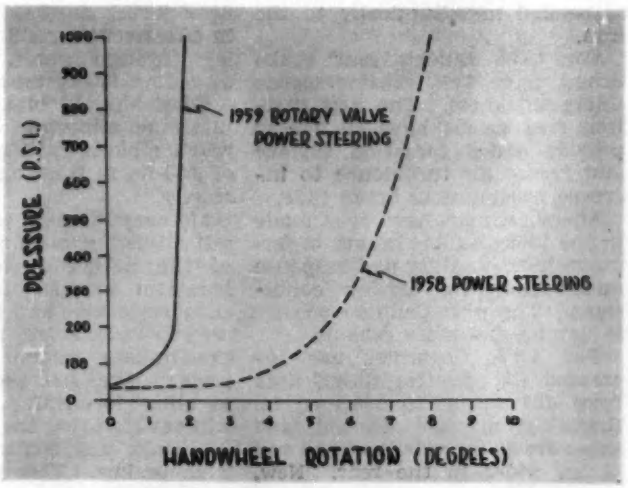
Compared with the 1958 system the new Saginaw power gear has 17 fewer parts. There are nine fewer external seals. Weight has been reduced 1 lb.

Returnability of the steering system to straight ahead position has been improved in 1959 and checking the oil level has been greatly simplified.

The 1959 valve functions by rotary motion. The new con-



Steering effort has been reduced substantially in the new rotary-valve power steering unit developed by Saginaw Steering Gear Division.



In addition to reduced effort, the new Saginaw rotary-valve steering gear is much faster and more sensitive to the driver's wishes. The new system builds up full pressure after a 2-deg turn. This compares with an 8-deg turn required by the 1958 design.

struction allows the valve to be actuated by rotation of the spool within the valve body, rather than by axial moving of the worm or through a cam-type device.

In the 1959 Cadillac steering wheel movement required to operate the valve is about one-quarter the wheel travel required to make the same valve movement in the 1958 Cadillac. Parking has been simplified.

Chevrolet is using a 24/1 steering gear ratio instead of the 20/1 ratio used last year. The 20/1 ratio is retained for power steering.

Most 1959 Chrysler models offer a steering wheel having a reduced upper arc. This new design permitted raising the wheel, providing more room for the driver.

Lincoln power steering has been redesigned so that in normal straight driving the pull on the steering wheel has been reduced from 3 lb to 1 lb. Time lag has also been reduced.

A flexible joint in the steering shaft, located just above the gearbox, is used on the 1959 Mercury. It consists of two steel flanges separated by a fabric-rubber disc. The steel flanges are splined to the shaft.

Power steering ratio has been reduced from 24 in 1958 to 20.5 in 1959. The number of steering turns has been cut from 4 1/3 in 1958 to 3 2/3. Lower steering and parking effort is required for 1959.

Studebaker has a new variable-ratio steering gear, which provides faster response but requires less turning from full left to full right. Recovery is also improved.

Brakes . . .

. . . reflect the search for better, more reliable stopping power. Improved resistance to fading is a primary objective. Cooler brakes and improved linings, including the use of metallic materials, are two major steps now being taken.

NEW 9-in. self-adjusting Wagner brakes are offered by American Motors as optional equipment on Rambler American and Six. Bendix brakes are used on both V-8 series. The rear wheel brakes on all Rambler 6 models have double-acting wheel cylinders. Usable brake lining thickness has been increased 30% on all 1959 models.

Buick is continuing with aluminum front brake drums. Improved heat transfer, better dimensional stability, and greater strength under difficult braking conditions are claimed for the aluminum drums. The aluminum is bonded metallurgically to the iron.

For 1959, Buick's rear brake drums have 47% greater usable lining thickness. The new cast-iron rear drums have 60 fins to provide added radiation surface and create air turbulence to increase resistance to brake fade.

Minor changes have been made in the 1959 Cadillac brakes to improve their stability and response under changing driving conditions. The new Cadillac booster is simpler and more reliable.

For 1959, Chevrolet has increased its effective lining area from 157 sq in. to 183.8 sq in. Brake drums are flanged and shoes are ¾ in. wider in front and ¼ in. wider in the rear. New, short-spoke disc wheels permit better airflow. The new disc wheels have 7 in. of ventilation area.

A Chevrolet Corvette innovation for 1959 is an option of heavy-duty brakes having sintered metallic linings. Lining sections are rectangular and are divided into segments. Six segments are riveted to each primary shoe; 10 segments are attached to each secondary shoe. High brake temperatures do not affect either the composition or the coefficient of friction of the new metallic linings and there is said to be virtually no tendency to lose effectiveness during hard usage. No loss in effectiveness results from driving through water. Resistance to fading is outstanding.

Edsel has automatic brake adjusters on all series for 1959. This year's models have brake widths of 2.50 in. in front and 2.00 in. in rear.

Mercury brakes for 1959 are self-adjusting on all models. Area of the brakes is increased on Monterey models. Improved resistance to fade and better recovery characteristics are claimed. The linkage system for Mercury power brakes has been simplified to allow for dealer installations without changing the brake pedal.

Lincoln will continue to offer wide brakes. This year's model has 262 sq in. of lining area, an increase of 44% over 1958. The self-adjusting feature is being continued.

Drum area has been increased by Oldsmobile to provide more cooling. Each brake lining has a full length groove to equalize pressure over the entire braking surface. A new lip expander insures more effective sealing at the brake wheel cylinder. Anchor plates, riveted to the backing plate, adjust brakes automati-

Typical of recent brake developments is this new flange on the 1959 Oldsmobile brake drums. With 88 sq in. additional exposed surface area, heat dissipation is improved substantially. Olds' wheels are also positioned outboard for greater exposure of the brakes to cooling air.

cally. New flanges add 88 more sq in. of exposed surface area. Wheels have been moved outboard.

Pontiac body design changes have made it possible to move the brakes out from inside the wheels toward the center of the car for improved dissipation of heat. A cooling flange has been added to the front drums and total drum weight is increased 39%. Lining width has been increased ¼ in. Lining effective thickness is increased 26.6% and total lining contact arear 9.4%. The brake shoe structure has been modified to give greater braking effectiveness.

For 1959 there is improved interchangeability between manual and power braking systems.

Studebaker's brakes for 1959 are oversize, self-centering and self-energizing.

Frame . . .

. . . changes had to be made to accommodate today's lower cars. This year's wider bodies introduced another factor influencing frame design. Pontiac has capitalized on this situation by introducing the "wide track."

THE outstanding feature of the 1959 Pontiac is a big change in wheel tread. Distance between the right and left wheels is increased nearly 5 in. Improved stability, additional riding comfort, and better cornering are claimed for the new design.

Other advantages inherent in Pontiac's wide track (when combined with the 1959 body changes) are (1) greatly improved accessibility to the engine, (2) lower under-hood temperatures, (3) reduced susceptibility to vapor lock. There are also advantages in brake and spring design, it is claimed.

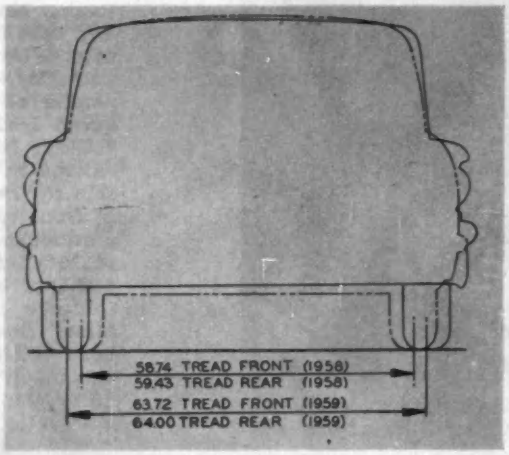
Pontiac's tubular center X-frame has been redesigned for greater strength and rigidity. Outward movement of the springs has permitted the use of lower spring rates without loss of roll stability.

Wider, K-type frames, with boxed-in side rails, are used on all 1959 Buick models. This new frame has less beam deflection than the 1958 design and retains high torsional strength and rigidity. Rear axle kickup has been increased. Overall width of the frame is also increased.

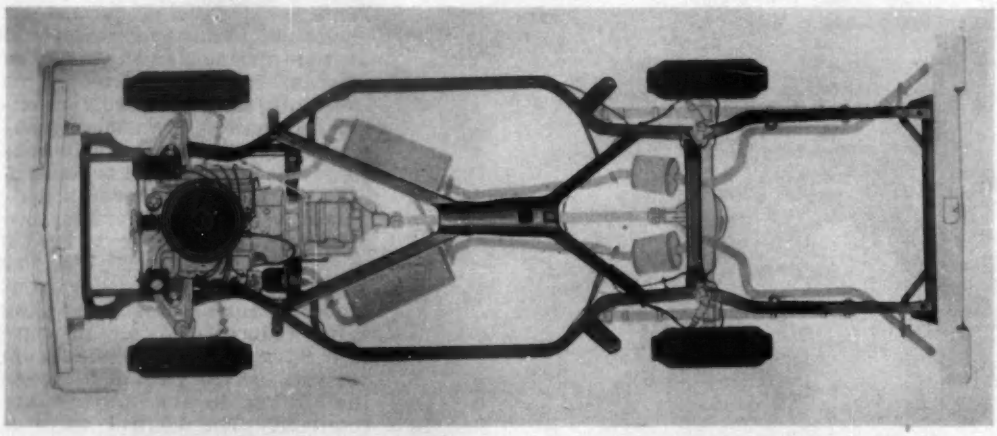
The 1959 Oldsmobile frame is 9 in. wider and 10 in. longer than the 1958 frame. Box construction side members are new. The body of the car is now anchored directly to the frame side rails and to inboard brackets.

Box construction is used by Oldsmobile for pillars, headers, roof rails, and rear seat frames. The floor pan has been ribbed to prevent "drumming."

(continued)



Pontiac's tread has been widened nearly 5 in. for 1959. Overall car width is also increased.



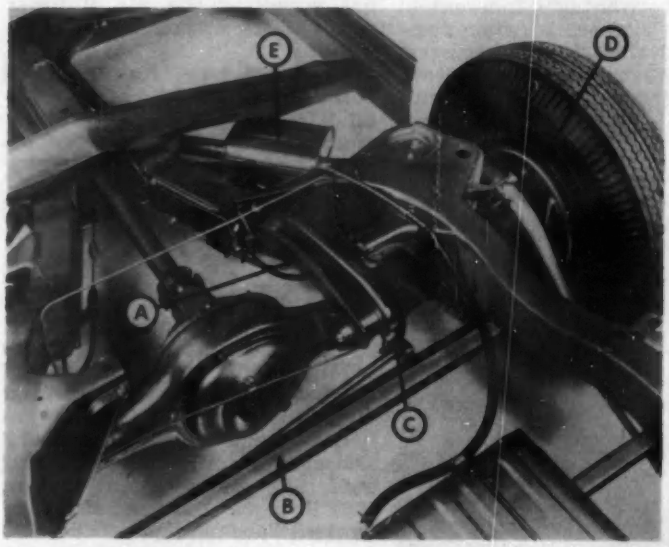
To meet the requirements of its wider bodies, Oldsmobile's new frames are 9 in. wider and 10 in. longer than the 1958 frames. The design has a new X-member and a heavy steel center tunnel. The main body is now anchored directly to the frame side rails.

Suspension Systems . . .

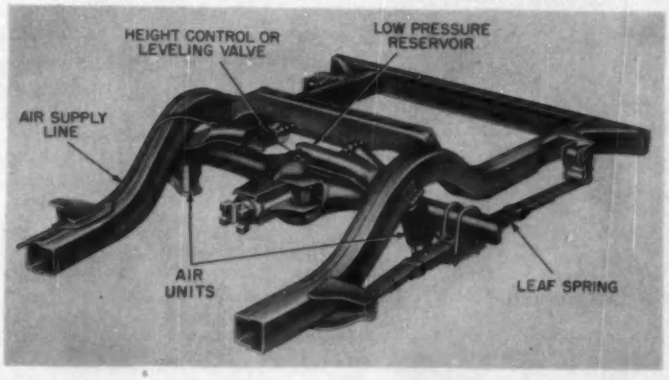
. . . continue to draw a major share of engineer's attention. This year Buick abandoned air springs in front; Chrysler offers optional air springs in the rear for leveling. Cadillac's freon-filled shock absorbers are the first to be used in U. S. cars.

THE 1959 Buick equipped with air suspension has two coil springs in front and two air springs in the rear with individual levelizer controls. Rear air spring pressure is 100 psi. Designed spring rates at the rear are approximately 55% of coil spring suspension for a distance of 1 in. on each side of normal trim height. Variable spring rate at the rear becomes effective if the wheel moves into compression or rebound beyond 1-in. travel. Compression travel has been increased to 5 in. in the rear.

Buick uses a modified closed system in which air discharged from the springs is returned to the compressor by return tubes. Thus, air is lost from the system only when springs discharge when the engine is not running. In addition to a soft, boulevard ride, the Buick suspension, it is claimed, provides superior roadability on winding roads and automatic trim control, regardless of the load.



Chevrolet for 1959 has made a number of suspension changes, including (A) new rear suspension upper control arm, (B) new frame crossmember, (C) a second suspension control arm to limit lateral movements of the axle (D) new brakes with greater lining area, (E) a resonator to soften exhaust sounds on V-8's.



Automatic car leveling for extreme load conditions is now available on Chrysler's Torsion-Aire suspension. Air cylinders are used in conjunction with rear leaf springs.

Advances in the Chrysler suspension system for 1959 include a new, infinitely variable cam adjustment, new torsion bars with improved anchor point seals, and redesigned ball joints. The new cam-type adjustment permits simple, precise adjustment of caster and camber. The new anchor-point seals prevent the entry of water or dirt into the space between the hexagonal end of the torsion bar and its socket. Torsion bars have been shortened on most Plymouth, Dodge, DeSoto, and Chrysler models. The diameter of the bar has been reduced 1/32 in.

There have been some modifications in Chevrolet air suspension for 1959, including reduction of front spring rates of 40% and a decrease in rear air spring rates of 15%. Other changes include a change in front and rear piston contours, new front bellows, and minor changes in valving. The net result of these design changes is a much softer, smoother ride.

Chrysler's new rear suspension automatic leveling control combines the features of the Torsion-Aire suspension with the advantages obtainable from air chambers. Flat cornering, level attitude during acceleration, and freedom from nose-dive during stops, all features of the Torsion-Aire suspension, are added to automatic leveling and nearly constant ride frequency, it is claimed.

In the Chrysler system, an engine-driven air compressor supplies air at pressures up to 220 psi to the high-pressure reservoir located beneath the right front fender. An automatic leveling valve reduces the air pressure to meet requirements (maximum pressure is 110 psi) and directs the airflow to the low-pressure reservoir. The control valve is mounted on the low-pressure reservoir and is connected to the rear axle by means of an arm and

a flexible rubber link. As the axle moves up and down, it moves the arm on the valve, admitting air to the low-pressure reservoir or bleeding it out.

About 10-psi pressure is required to keep the air chambers firmly seated when the car is jacked up.

Cadillac is the first car producer in the industry to use plastic sleeves filled with Freon gas in the reservoir of its shock absorbers. This feature eliminates the mixing of air with the fluid in the shock absorber while providing desirable volume variation and other characteristics needed for this application. Elimination of oil aeration by use of the plastic sleeve results in a highly efficient shock absorber which permits Cadillac engineers to develop a soft ride without compromising wheel control.

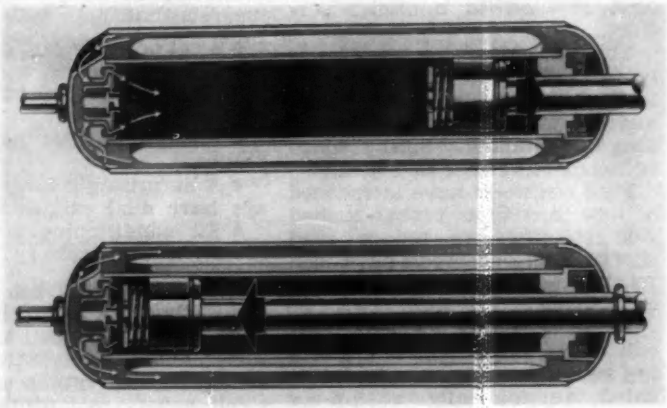
Buick's larger diameter front coil springs provide ½ in. more ride clearance.

A new fluid is used in shock absorbers to facilitate better year around control. The wider track of the 1959 models combined with lower center of gravity, permits elimination of the front stabilizer except on station wagons and air ride suspensions where front springs are very soft.

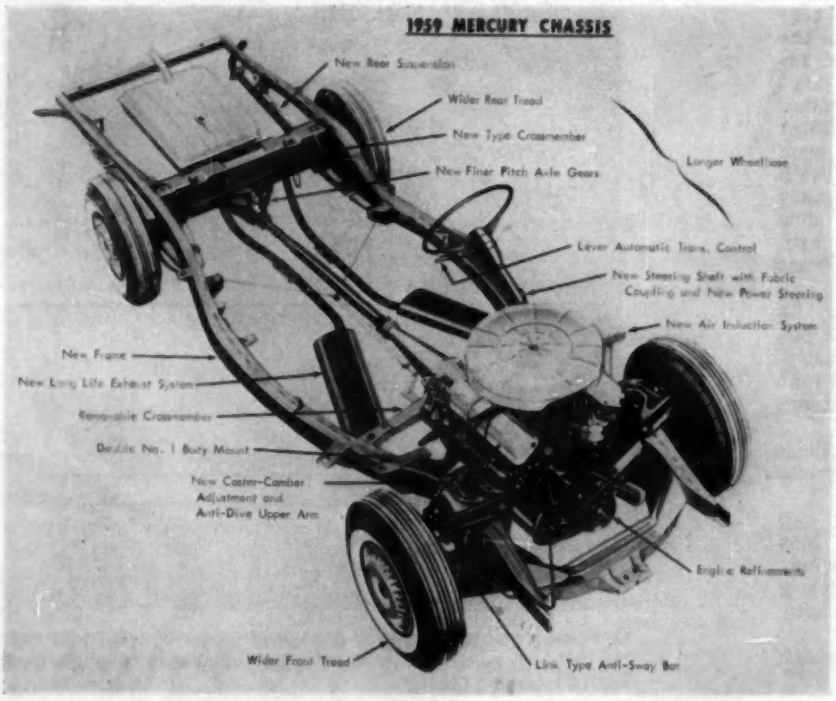
Changes made in the 1959 Cadillac suspension have been made primarily to provide a smoother, easier ride. Rear yoke rubber ball joint has been modified to improve ride softness.

Cadillac's air suspension has been modified primarily to provide a softer ride. Rate of the front air spring has been changed for better balance. Compressor noise has been reduced and the compressor is now lubricated by oil supplied by the engine. Leveling valve size has been reduced for 1959.

Chevrolet's 4-link rear suspension has been modified to give improved stability and roll-steer characteristics and to eliminate objectionable side reactions to the frame. The new suspension is reported to contribute to ride quality and retains vertical control in starting and stopping. A



Cadillac has introduced a plastic sleeve filled with Freon gas in its shock absorbers. The new arrangement positively prevents mixing of air and oil. Thus, action of piston against oil is held constant.



Changes in the 1959 Mercury chassis are typical of the new engineering designs that often go with a new body.

new single upper control arm works in combination with two lower arms to control antilift, antisquat torque reactions. Control arms are relieved of lateral loads by a new independent lateral control bar.

Edsel's 1959 front suspension is an independent short-long arm design with the leading edge tilted 3 deg upward and the lower arm swept back 20 deg. Front springs have the lowest rate possible for available space. Spring stress, size, and hardness have been selected to minimize settling.

The rear suspension has a lower rate than last year. The 3-in. additional length increases resistance to windup during acceleration and braking. Spring width is increased from 2 to 2½ in.

Ford engineers have introduced a new link-type rubber-bushed ride stabilizer to reduce road shock. Shock absorbers have been recalibrated to give a smoother, easier ride.

As an accessory for 1959, Lincoln front suspension and steering system bearings can be lubricated automatically at proper intervals. A positive-displacement vacuum pump supplies metered lubricant from a reservoir to 11 fittings.

Longer wheelbase, wider front and rear tread, a new antidive front suspension, and new rear suspension are available in the 1959 Mercury. Antidive is reduced 35% compared with 1958 models. Jounce and rebound bumpers are butyl rubber. Caster and camber adjustment has been improved and simplified with elimination of the customary shims. Knurled pads on a new adjustable upper suspension arm shaft improve service on front end alignment.

Oldsmobile's rear spring is mounted forward of the 1958 position to provide further resistance to acceleration squat. Front kingpin angle has been changed to reduce steering effort.

The low-pressure tank has been eliminated from the Oldsmobile air suspension system.

New variable rate front coil springs are specified in the 1959 Studebaker. Rear leaf springs have been redesigned to give a softer ride and reduce brake dive. Shock absorber valving is also new. The Studebaker tread width has also been increased.

Accessories . . .

. . . are leaning strongly toward pushbutton operation and control. More than a dozen of today's accessories are push button actuated. Chrysler has new electrically operated heater control and headlamp dimmer and Buick has new automatic heater.

ACCESSORIES have always been an important part of the U. S. automobile package. How big a factor are they today?

While 1958 figures are not yet available, a study of Table 1 suggests that:

- 4 out of 5 new cars have automatic transmissions.
- More than 40% have power steering.
- About one-third have power brakes.
- A surprisingly large percentage have dual exhausts.
- Air conditioning is climbing rapidly as an accessory.

Here is a partial list of accessories that are controlled by a push button: heater, air conditioner, antenna, ventilation, radio, ventipane, convertible top, windshield wipers, rear windows, electric seat, electric deck lid, transmission, pushbutton lubrication, and garage door opener.

Buick for 1959 is offering automatic heater controls. Both the heater core and the air distribution system are new. Controls for the new system have been redesigned.

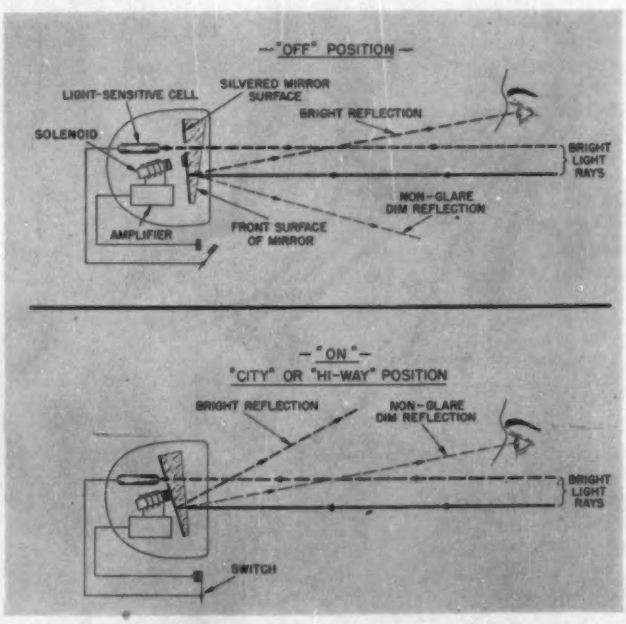
The 1959 blower switch is interlocked with two control levers. One lever controls the amount of air to the defroster; the other lever controls the heater air and the temperature of the air.

There is an automatic override on the "de-ice" position of the defroster lever which gives maximum heating and blower regardless of the location of the heater lever.

The automatic heater control consists of a temperature control valve which controls discharge air but is automatically adjusted for ambient and in-car temperature. The control temperature can now be set and left in this position until a change in car temperature is desired.

A new electronically operated, self-dimming rear view mirror is available on Chrysler cars for 1959.

A photoelectric cell, housed in



Optional for Chrysler in 1959 is an electronic inside rear view mirror that flips automatically to deflect objectionable headlight glare from a following car.

the mirror, generates a small electric current. When light intensity becomes strong enough to annoy the driver, the current activates an amplifier and a solenoid assembly. This pulls the mirror a few degrees upward, reflecting a dim image off the mirror surface. As long as intense light is present, the mirror remains in the "dim" position; the mirror returns to normal position automatically.

Chrysler is also offering a new automatic headlamp dimmer. The device uses a light-sensing cell to scan light from oncoming cars. Headlights are lowered automatically when the oncoming car is 900–1200 ft away. The dimmer also responds to taillights of a car 200–500 ft ahead. The range is adjustable by turning a knob on the back of the scanner. The dimmer is mounted on the instrument panel. It can be overridden by exerting pressure on the foot-operated dimmer switch.

Optional at extra cost on all models is a new remote-control side view mirror. Its position is precisely controlled from inside the car by moving a lever on the left side of the instrument panel.

For 1959, five pushbuttons located on the console of the instrument panel control all of the functions of the heaters in Chrysler Corp. automobiles. In Chrysler models, the buttons are labeled "off," "hi," "lo," "def" (defrost) and "air." Pressing the "hi" button delivers the maximum amount of warm air for quick comfort and rapid defrosting. Both the "lo" and "hi" buttons control blower speed. When the "def" button is pressed, 60% of the air is directed upward against the windshield. The "air" button provides summer ventilation.

Pushbutton air conditioning is also offered on all Chrysler Corp. cars. The sliding temperature control works the same as on the heater.

The Chrysler air conditioning system can be used to dehumidify warm incoming air on cool, damp days when the car tends to "steam up" inside. New, swivel-type outlets, located on the instrument panel, direct airflow as desired. Two auxiliary cooling units are available for sedans, hardtops, and station wagons in 1959.

Ford's new heater is reported to give instantaneous response and more even temperature control. The new heater uses mechanical dampers to mix hot and cold fresh air instead of modulating the water temperature in the heater core. The new method of control eliminates "hunting," according to Ford engineers. Mercury has a new air intake and heater system which blends warmed outside air and cool outside air to give passengers a comfort zone of warm air. Better temperature control is claimed for the new heater system.

Table 1 — Factory Installed Accessories

Automatic Transmissions	High	Low	Industry
1957	100	58.7	79.9
1956	100	54.9	74.8
Power Steering			
1957	100	15.2	38.1
1956	100	6.1	27.7
Power Brakes			
1957	100	8.7	29.6
1956	100	5.9	23.9
Dual Exhaust			
1957	100	13.5	—
1956	100	10.4	—
Air Conditioning			
1957	33.0	0.4	
1956	25.0	0.2	

Body Styles	1957	1956
Station wagon	13.6	11.3
4-door hardtop	14.6	12.0
2-door hardtop	18.3	18.9
4-door sedan	32.6	34.0

Bodies and Sheet Metal Engineering . . .

. . . The trend toward lower bodies continues; some bodies are longer than last year; each of the GM bodies is wider than a year ago. Bucking the trend toward bigness is the new Studebaker Lark, which is 3 ft shorter than the average U. S. passenger car.

OVERALL height of American passenger cars has been reduced with every model change since World War II. This trend is continuing. Several things are being done to solve the problems introduced by the low silhouette. Most cars already feature a step-down floor. This year, Chrysler has introduced a stepped-roof design to gain more headroom and leg room. Propeller shafts have had to be changed to keep down tunnel height and gain room under the rear seat.

However, the most significant body engineering changes are: (1) extending the hood to nearly the middle of the front fenders, and (2) increasing body width as much as 3.3 in. These changes are featured in the 1959 General Motors cars.

American Motors will continue to offer four lines of cars in 1959; the Rambler American, the Rambler 6, the Rambler Rebel V-8, and the Ambassador V-8 series.

Minor refinements in body sheet metal and grille have been incorporated in the 1959 models. Both front and rear bumpers have been redesigned. Bumper steel thickness has been increased 22.6%.

The roof panel of the Rambler American station wagon has been reworked to provide a flatter roof, bringing overall height down to 57.8 in. A new rear folding seat system is offered for 1959.

A windshield wiper of new design has increased wiper speed by 50%. Area swept by the wiper is increased by 10%.

An entirely new feature for 1959 is the introduction of individually adjustable, separate reclining seats as an option. The front cushion is divided. The two seats are fitted with separate tracks so the driver and the front seat passenger can make individual fore-and-aft adjustments.

Also new for 1959 are individual

Individually adjustable front seats are a feature of the 1959 Rambler. Seats are fitted with separate tracks so both driver and front seat passenger can adjust seat independently.

front seat head rests. These may be used singly or in pairs. They easily removed by pulling them out of the socket.

Improved insulation is contributing to quiet, relatively vibration-free motor cars. Buick, for example, is providing improved noise absorption with the use of new insulating materials. Insulation is used generously under the hood. Polyurethane floor pads are specified. New rubber mounts reduce road noise.

Cadillac has an entirely new body for 1959. The car has been lowered 3–5 in. Length is about the same as it was in 1958. Most significant design change is the fact that the hood is much wider, opening to the middle of the front, fender crown molding, eliminating the previous joint line between the hood and the fender. This change gives greatly improved accessibility to the engine compartment.

The 1959 Chevrolet sedan bodies are about 2 in. longer, 1 in. lower and slightly over 2 in. wider overall. Some interior width dimensions have been increased as much as 4 in. For the first time, the Chevrolet station wagon is as low as the sedan.

Numerous refinements have been made in the 1959 Chevrolet body. The front bumper is located almost 5 in. higher this year. Front overhang is reduced 3.2 in. The change makes it possible to enter steep driveways with less likelihood of scraping.

In the front passenger compartment, the toeboard angle has been changed to provide more leg room. In the rear compartment of the sedan, the floor is lowered and extended deeper under the front seat. Because of longer bodies this year, station wagon compartments have 8 ft of usable cargo length with the tailgate closed. Reduced front seat height has resulted in increased headroom for passengers.

Overall visibility area has been increased up to 50%, including windshield areas that are 53–61% larger than last year. Rear window visibility area has been increased up to 74%. The increase is accomplished, primarily, by extending the glass into the roof.

Many structural changes have been made in the 1959 Chevrolet bodies. Heavier gage steel is used in the roof panel. There are full box-section headers over the windshield and the rear window. Integration of the roof rails into the lower body has been improved.

The new cowl structure permits more airflow through the ventilation system. The hood panel, much larger than a year ago, has additional reinforcement at the sides.

Other significant body features of Chevrolet for 1959 include the use of extra insulation on Impala and Nomad models and use of a retracting rear window on all station wagons.

The 1959 Chrysler Corp. automobiles have new fenders, hoods, bumpers, grilles, headlamps, and exterior molding treatments. Headlamps have been lowered into the grille area. Dodge, DeSoto, and Chrysler 4-door hardtop models feature a new stepped-roof design, which provides additional rear seat leg room and headroom. The sculptured roof has a new backlight of approximately 15% greater glass area. New, super-quality enamels are featured on all Chrysler-built cars. Waxing is not required for the first two years.

Chrysler interiors for 1959 feature a glare-proof safety cushion on the instrument panel for protection of front seat passengers. On Chrysler and Imperial models, safety padding is available on the back of the front seats for rear passenger protection.

Chrysler's new swivel front seats can be swiveled outwardly when the front door is opened. In their normal position, the seat cushions meet at a stationary center pad, forming a continuous bench seat. When entering the car, the driver or front seat passenger releases the seat by lifting a lever on the side of the seat. This releases a spring which swings the seat outward approximately 40 deg. Rubber bumper stops, plastic rollers, and pivot bushings are used to insure quiet operation.

Improved front seat accessibility is the principal advantage of the new Chrysler swivel seat design. However, there is also improved accessibility for rear seat passengers entering 2-door models.

The new swivel seats have 3 in. of foam rubber in the cushion and 1 in. of the same material in the back.

The 1959 Edsel bodies have bumper mounting bracket bolts that are spread farther apart to improve jacking strength. Parking lights are further inboard for lens protection and to provide better side illumination. A new and improved hood hinge is used to reduce lateral hood movement.

The well in the luggage compartment has been eliminated and the spare tire rests in a horizontal position in an embossment over the rear axle.

Ford's 1959 all new body embodies many of the characteristics of the highly successful Thunderbird. The 1959 Ford line includes 17 models. Custom 300's are 6 in. longer than the 1958 models. Station wagon length has been increased 5 in. and cargo area is 8 in. longer, adding 11 cu ft of cargo space.

Windshield area has been increased 280 sq in.

For 1959, Ford is featuring a new super-enamel. No waxing is required during the lifetime of the car. The new paint is also reported to be 50% more chip resistant.

Numerous refinements have been made in the 1959 Lincoln and Continental unitized bodies which, it is claimed, are 35% more rigid in torsion than a comparable con-

ventional body-and-frame unit.

An interesting development in the Lincoln and Continental body development is immersion of the body in a special rust-resistant paint to provide better protection, both internally and externally, against corrosion.

Much attention has been given to sound insulation in the 1959 Lincoln. The dash insulator includes an additional layer of aluminum, after Fiberglas, to form an effective "sandwich" of materials. The improved barrier reduces sound level and makes it easier to cool the car with air conditioning equipment.

For 1959 Lincoln is offering an improved electric door lock that locks and unlocks all doors electrically.

In several models, Lincoln is offering dual-purpose reading lights instead of the more familiar dome lights.

New models offered in the Continental Mark IV line for 1959 include a limousine and a formal sedan. The restricted use of chrome and ornamentation is continued. Front end design has been changed and the long, low side look of these cars has been enhanced.

Mercury chassis and body are completely new for 1959. Length has been increased 2–4.5 in. The overall height is reduced ½–1 in.

Windshield glass area has been increased 60%. Slope is 52 deg compared with 43.5 deg in 1958 models.

Two rear windows are available, including a new compound curving rear window on hardtop models. The hood has been lowered to provide improved forward visibility.

Tunnel height is lower, both in front and rear compartments.

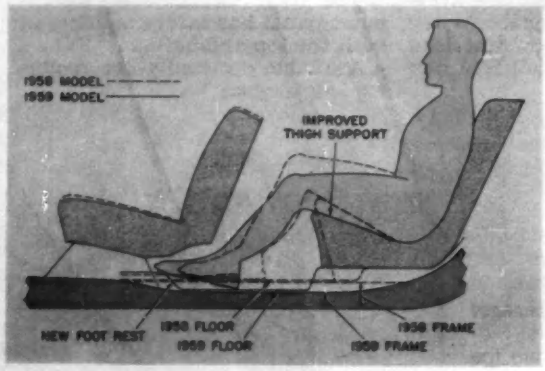
The rear compartment foot well area has been increased 4½ in. Front seat tracks are moved outboard.

Oldsmobile has added two completely new body styles in its 1959 line of cars. These are the 4-door Holiday SportSedan and the 2-door Holiday SceniCoupe.

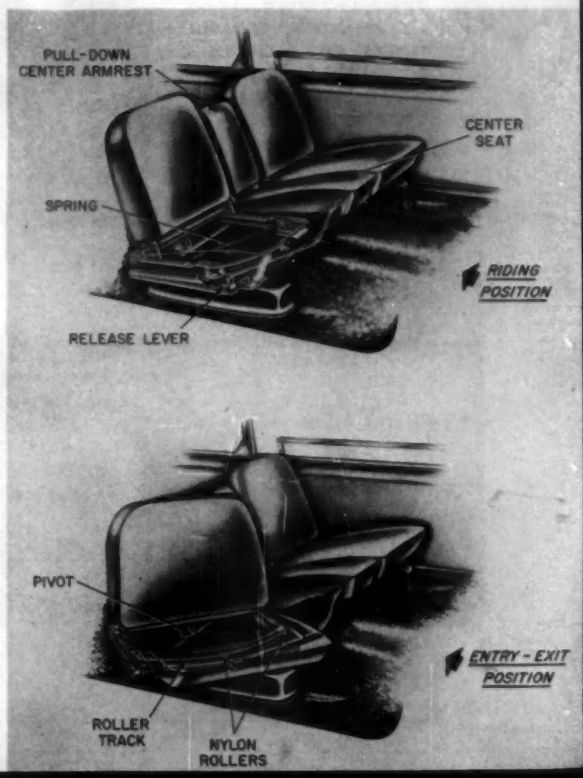
The 1959 Oldsmobiles have 46% more windshield area than last year's models. Backlight area is up 38% and trunk space has been increased 64% in the 88's.

Styling innovations include setting the headlamps apart across the front of the car and the use of "functional molding" (to prevent

In addition to improved visibility as a result of larger glass area, attention was given to headlamp locations. 1959 Chevrolet headlamps have been lowered more than 7 in. Parking lights are now located above headlights.



In addition to a stepped-roof in some models, Chrysler has lowered its floor pan to provide more leg room and foot room for rear seat passengers. Shown here is a comparison of 1958-1959 Imperial seating arrangements.



Chrysler Corp. swivel front seats can turn 40 deg without steering wheel interference. These seats are available as standard equipment or optional on all 1959 Chrysler lines.

paint chipping, for example.)

The new 1959 Pontiac bodies range from 2 in. to 9 in. longer. More significant is an increase of 3.3 in. in width. Body height, varying with body style, has been reduced by a maximum of 3 in.

The hood line has been lowered another inch.

Windshield visibility is up from 50 to 60% depending on body style. Total glass visibility area is substantially greater, a maximum increase of 37% occurring on the sport coupe. Approximately 6.8 cu ft has been added to the Star Chief luggage compartment, while storage area in the Catalina is 4.4 cu ft greater.

Electric windshield wipers replace a vacuum system.

Studebaker's new Lark series, nearly 3 ft shorter than the average American car, represents the second offering by an American manufacturer of an entirely new series of smaller cars. Lark series sedan and hardtop models have 108.5 in. wheelbase and overall length of 175 in. This is about 2 ft shorter than the previous Studebaker models. Although they are shorter, the new Larks are actually roomier inside than comparable 1958 models.

Loaded height of the 2-door sedan is 57.5 in; width at the center pillar is 69.0 in. The 1959 station wagon wheelbase is 113 in. Studebaker is also offering its Silver Hawk series for 1959 on a 120.5-in. wheelbase.

The Studebaker Lark features a distinctive grille, and a minimum of chromium. Single headlamps are used. Fender panels have been made removable for easy repair.

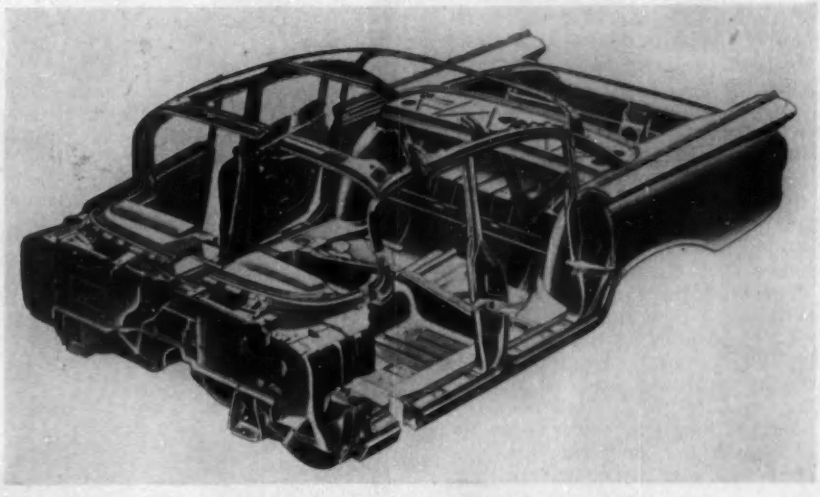
The 1959 Studebaker instrument panel has safety padding at both the top and bottom.

Available optionally are reclining front seats. Each seat is adjustable to seven positions, including a bed position which brings the back of the front seat level with the rear seat cushion.

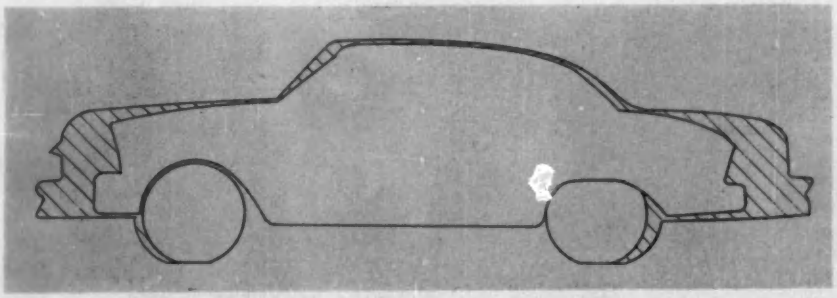
New body finishes available on many of the 1959 cars have several advantages, including better luster retention, improved resistance to staining, and wider adaptability to high-metallic pigments.

In most areas of the country, no car polish should be required for two or three years. Where there is constant exposure to sunlight and high humidity, mild polishing after about a year may be necessary.

For 1959, General Motors is using an improved priming paint that is reported to have good resistance to chipping, particularly when the car is struck by flying stones or gravel. An improved underbody paint has also been introduced by General Motors.



Typical of body changes in the wider General Motors cars for 1959 are the following: new double-wall cowl panels, box-member construction in pillars, headers, roof rails, rocker panels, and seat frames; and a channeled and ribbed floor pan. Shown here is the 1959 Oldsmobile.



Passenger roominess and comfort have not been sacrificed in the new Studebaker Lark series. The 1959 Studebaker is about 2 ft shorter than earlier Studebaker models. Elimination of overhang in front and rear accounts for practically all of the change in length.

chips

from SAE meetings, members, and committees

"TRAIN A PERMANENT NUCLEUS of workers to perform many different kinds of jobs . . . Take your labor fluctuations in unskilled and semiskilled workers." That, says Bausch & Lomb's W. D. James, is the best chance a job shop has to hold down hiring and firing costs . . . which must be done if the job shop is to make a profit.

MAN'S CARDIOVASCULAR REFLEXES may be dulled by prolonged exposure to zero g stress, speculate scientists at Douglas Aircraft. The condition is compared to that of a bedridden patient. This is one of several varying ideas about the biological effects of weightlessness. To combat this effect, the crew will need to exercise regularly. And space cabins will have to be designed to allow for such activities.

"HOT-STALL" is one 1958 gremlin that engine designers are finding ways to overcome in newer passenger-car powerplants. . . . Some 1958 engines wouldn't start when hot. The starting motor wouldn't crank the engine until the engine was allowed to cool for 30 sec or more. Some drivers were most embarrassed when stalled in the midst of traffic and intersections.

Studies using an oscilloscope showed that, in such cases, the engine was really "dieseling." The fuel charge in the combustion chamber was burning prior to the ignition spark, and the burning was occurring far enough ahead of top dead center so that the engine tended to run backwards. . . . The high compression ratio of some 1958 engines squeezed the fuel charge to such a high pressure that it raised the temperature of the charge to its ignition point.

It was determined that, if these engines were cranked faster, they would start. Higher acceleration during the compression stroke delayed the peak pressure buildup of the fuel explosion until it was past top dead center. So, starting motors were designed to produce 1.62 hp (and weigh 23 lb) to furnish the faster cranking — and were first used on 1958 cars.

The saint changes persecutions into blessings; the sinner into alibis. Most of us do a little of both.

VTOL AIRCRAFT can survive power failures near the ground better than conventional aircraft because of their take-off dynamics and landing gear. If power fails 50 ft above the ground, both types of aircraft have the same potential energy but the regular aircraft also has its forward inertial energy to dissipate. Also the landing gear of a VTOL aircraft is still in operating position, while conventional gear is usually being retracted, by the time 50-ft altitude is reached.

"THE moderator is something that slows things down," said a speaker at a recent SAE panel discussion to a startled audience and a more startled panel moderator. But it turned out he was referring to the kind of moderator that controls a nuclear reactor.

PISTON ENGINES will continue to be used in passenger cars until 1980 says Joe Bidwell of General Motors Research. Of course, further improvements are expected to take place during that period.

CURRENTLY, U. S. Ordnance is trying for multifuel systems in three ways . . . a divided-chamber engine designed to control the prechamber temperature at a high level both at light and heavy load . . . continuance of work on its LD-427 Ordnance engine converted to the M.A.N. system using manifold flame heaters . . . and studies on a 5¾-in.-bore aircooled cylinder, utilizing the same combustion system as the 427 development and involving the effects of large bore size on the M.A.N. principle.

A NEW WRINKLE has entered the car radio business. Antenna manufacturers have received an urgent plea from the New York City Police to change the ID of the bottom part of their antennae. It seems the youths of the city can make "zip" guns out of the tubing because it has a 0.22 in. bore. Police Commissioner Kennedy reports that of 300 zip guns seized since July 1956, all but three were made from antennae.

This may remind some engineers of the standards work done on lock washers to make sure they didn't fit telephone coin boxes.

ANOTHER definition of "expert" (phonetically):

ecks — former

spurt — a little drip under enormous pressure

industry's role

the time has come when some mental gear-shifting is in order to line our ideas up with the new pattern of defense participation that has been developing in recent years.

The concept of change in industry's defense participation is not, of course, peculiar to this period of time. These things have been changing as far back as I can recall, and a static condition is hardly to be expected when we are dealing with a fast-moving technology in a dynamic society. However, it would appear that we are now experiencing something more fundamental than the usual evolutionary changes of procedure and policy.

the trends

Underlying industry's changing role are certain trends that have been developing in military aeronautics.

1. The main tide of development has been moving for a long time toward more efficient defense equipment of ever-increasing individual capabilities. The trend appears to be inevitable, and it is not necessarily unfavorable from a logistic or economy standpoint. A ten-fold increase in the weight of heavy bombers, for instance, is not unacceptable if it is accompanied by a thousand-fold increase in effectiveness, or if it is necessary to attain an essential objective. Defense technology must at all times be measured against current and future need rather than against history.

2. With the growing refinement of weapon function there has developed an increasing specialization in technology. It was not so many years ago that the main channels of air development were threefold: airframe, engine, and propeller — with a few additional parts and devices picked up here and there from other industries that, for the most part, regarded aviation as a sideline. Today a large part of the aeronautical development effort is in highly specialized electronic, mechanical, and chemical laboratories — with nuclear laboratories also getting into the act for future applications. The degree of specialization is often very great within these broad categories of technology, so that a given organization may achieve a clear superiority over its competitors in one particular field, such as a certain type of radar, but be less proficient than one or more of its competitors in other fields that seem closely related.

3. As the capability of each unit of equipment has increased there has been a decline in quantity requirements. The emphasis is upon conception rather than duplication, upon development rather than production. Never again, for example, will

Excerpts from address by

J. L. Atwood

president, North American Aviation, Inc.

in defense is changing

any airplanes reach the 10,000 and 15,000 production runs of the Mustangs, Liberators, and Flying Fortresses of World War II. Atomic weapons have vastly increased the destructive payload of each vehicle, and it is doubtful if even missiles of the larger types will ever be required in quantities comparable to the aircraft runs of World War II.

4. Increasing development cost has resulted in competition being decided at an earlier stage. On rare occasions, such as the recent competition for jet utility aircraft, we still have demonstrators constructed under private sponsorship, but where combat specifications are concerned the speculative prototype went out about 20 years ago, principally because the cost became prohibitive. North American's Sabreliner jet utility demonstrator, which made its initial flight in mid-September, is costing our company many millions of dollars. Obviously no company can afford many competitive bets of this magnitude, not to mention the far greater costs involved in developing a modern fighter or bomber. The trend today, therefore, is toward selection by the government of a competent contractor, usually on the basis of a careful appraisal of capabilities and plans, often supplemented by paid studies. The competitive decision often occurs several years and millions of engineering hours before the existence of a prototype.

5. The increasing cost of equipment has also resulted in greater reliance upon each line of development. As recently as the Korean War period there were usually several different types of air vehicles available to meet each general requirement. That is, the Air Force had two or three day fighter models, the Navy two or three carrier-based attack aircraft, and so forth. Today, however, this kind of insurance has become excessively costly, and has been used only in a few rare instances where the technical gamble was so great that two approaches were considered essential, as in the field of ballistic missiles. In most other instances the individual services have placed full reliance upon a single line of development to meet a particular requirement in a particular time period. Parenthetically, this does not mean, of course, that the nation is limited to a single approach. There is a certain amount of overlap in the requirements of the various services, so that at a given time in the future we may have a number of different ways available, for example, to attack a given target overseas. Some of this apparent duplication is desirable from a military standpoint, since it vastly increases the defensive problem of a potential enemy.

The significant trends are, in summary, the increasing intricacy of defense equipment, a growing specialization in technology, the increased emphasis on developmental aspects, a trend away from direct performance competition toward competition based on managerial and technical capability, and an increasing reliance upon each line of development. Closely related to these trends has been the emergence of the weapon system concept and the gradual assignment of increasing responsibilities to industry for management of development under this concept.

company must be flexible

Inevitably these basic changes are having substantial effects upon the structure and operation of defense industry. For example, the declining number of programs and the changing character of defense work have made it necessary for organizations to step into unaccustomed roles in order to find ways of making the defense contributions of which they are capable. We formerly thought of companies as fitting into certain categories with respect to the nature of their products and their mode of operation in defense work. We had airframe companies, engine companies, hydraulics companies, instrument companies, and so forth. From a contractual standpoint we had prime contractors and subcontractors. Today these walls of classification have fallen, and there is a new flexibility in most companies through which their resources can be applied in whatever area and manner may be most beneficial to the nation. A given firm may be a prime contractor on one program and a subcontractor on another. It may undertake a complete weapon system today and a small component of a subsystem tomorrow.

The net effect of all this is to increase the competitive factor and bring a maximum of fresh thinking to each problem, large or small.

In many recent competitions 20 or 30 different organizations have sought to convince a government agency or prime contractor that they were best qualified to accomplish a given development job. As long as it is held within reasonable limits of effort and constructively directed, this broad sampling of many approaches should prove to be in the nation's interest. Also, from the standpoint of each organization, it is contributing to a better understanding of problems beyond traditional areas of activity, thereby making possible better coordination and integration of effort.

Our company at present holds weapon system management responsibility, as prime contractor, for three important manned weapon systems. These are 1) the A3J-1 carrier-based attack system for

industry's role in defense is changing . . . continued

the Navy, which our Columbus Division is now flight testing, 2) the B-70 intercontinental strategic weapon system, and 3) the F-108 long-range interceptor. Both the B-70 and the F-108 are being managed by our Los Angeles Division for the Air Force.

Through these divisions and others, we also undertake to supply as subcontractor or associate contractor various systems and components in the structural, electronic, rocket engine, and atomic energy areas. After our prospective customers learned to accept us as qualified in each field of activity, we have had no particular problems in this defense equipment diversification. Inevitably our overall management capability has been increased in the process.

Many other companies, both in and out of the aircraft industry, are diversified to the same or a greater degree. Some are competing with us, selling to us, and buying from us all at the same time. This certainly is a new order of things. It seems the only way for the nation to utilize fully all the resources available to it in the present state of defense technology.

The trends toward more intricate weapon systems and more specialization have had another related effect: namely, the formation of developmental teams comprising elements from a number of companies to solve particular problems. These voluntary working relationships of independent firms are something new in the defense procurement picture. They permit relatively small companies to join resources and thereby achieve a developmental capability that may be competitive in projects far beyond the scope of any single member. They permit large and small companies to bring together, on a basis that evokes the finest kind of coordination and teamwork, their various specialized skills, facilities, and innovations. Essentially this technique, like company flexibility and diversification, is a means of utilizing our technical resources to the maximum possible degree. It accomplishes, through voluntary association motivated by mutual interest, the integration and application of specialized skills that in a regimented state could result only from government plan and direction. Coordination resulting from government edict can ever be as vigorous and effective as this voluntary teamwork now being generated in our private enterprise defense industry.

Another effect of the underlying trends cited — this one related to earlier competitive decisions, greater dependence upon each line of development, and greater reliance on industry — is an increasing need for effective evaluation and effective management. Today the buyer of advanced aeronautical systems does not have physical articles to examine, weigh, fly, and otherwise test and compare before making a decision. He does not even have completed engineering designs on paper to evaluate. Instead, in many major instances, he must award the business on the basis of preliminary design concepts and a careful comparison of company resources and capabilities.

management skill counts more

Once the contract has been awarded, there is a high premium upon management skills both in government and industry to insure that the concept selected is brought through development effectively, economically, and on schedule. The allowable margin for error is very low in the more important systems, and there is no tolerance for failure when performance of a given mission depends upon success. Not only does this put a very high value upon management capability, but it has many implications in the area of technical thoroughness — affecting for example the extent of research prior to development decisions and the scope of provisions for testing and proving. It is impossible to achieve technical progress without courage and imagination, but these qualities must be alloyed with judgment. The technical paradox is that we must take a chance and then do such a thorough job that it becomes a sure thing.

There are a number of other characteristics of industry's changing defense role that are important, including contradictory tendencies toward increased risk and reduced profit rates. These are very large problems. The wisdom and foresight displayed by responsible defense procurement officials in developing other phases of the relationship between government and industry are certainly going to be needed in working out the financial aspects of the new relationships. Techniques have been developed for applying the best talents of a large segment of American industry to an increasingly complex defense technology. It is essential that these techniques not be compromised and nullified by short-sighted fiscal and contractual policies.

The 2000-mph-plus B-70 bomber and its corollary, the F-108 interceptor, each involve about a dozen principal systems in addition to the airframe. This means that more than a score of major members of the weapon system teams must be selected and coordinated by our firm in its capacity as weapon system contractor. This is essentially a procurement and engineering management task. In addition, of course, we have the responsibility of developing and constructing the airframes of both weapon systems.

Our approach to management responsibility under these two weapon system programs includes five points:

As a first point, we are making a maximum effort to bring the most highly qualified bidders into fair and effective competition for the major system awards.

We are keenly aware that the success of the B-70 and F-108 weapon systems will depend to a large

degree upon the capability and performance of the firms that are awarded responsibility for development of major systems. Therefore it is essential to us that the best qualified organizations be encouraged to compete for this business, and that our evaluation of design proposals and related capabilities be as thorough and objective as we can make it. In this connection, survey teams sent out to inspect the facilities of prospective contractors have already traveled half a million passenger miles by air, visiting plants in 90 cities throughout the country.

The reports of our survey teams are evaluated by a source selection board consisting of the heads of our engineering, manufacturing, tooling, purchasing, quality control, and pricing activities in the Los Angeles Division. This board compiles a qualified bidders' list, which is sent to the Air Force Weapon System Project Office for approval.

These qualified bidders are invited to a conference at which they are thoroughly briefed on the requirements for the subsystems and on the performance that would be expected of them as major system contractors. Those who still choose to remain with us following the bidders' conference are given from six to eight weeks to work up their detailed proposals showing how they plan to accomplish the development objective. If the bidder desires he may accompany his written proposal with an oral presentation. As a safeguard against oversight in the preparation of the qualified bidders' list, we will accept a bid from anyone who submits one even though he is not on the original list.

The proposals are then reviewed carefully by individual evaluation committees qualified to judge the technical design, technical capability, production ability, probable cost, and program management factors. The combined recommendations of these individual committees go back to the source selection board, which chooses the major system contractors subject to the approval of corporate management and the Air Force Weapon System Project Office.

As a second point, we propose to maintain very close working coordination with the contractors selected to handle major systems of the B-70 and F-108. A resident representative of our company will be located in the facilities of each major system contractor. A plan of technical reporting and milestone check points will be established to facilitate the necessary technical coordination with the various contractors. We have always kept in close touch with our subcontractors and suppliers, and in the instance of the B-70 and F-108 the nature of the joint developmental undertaking will require the closest kind of teamwork.

Third, we are determined to operate with short lines of communication, minimum red tape, and prompt decision-making. Most defense contractors, ourselves included, have at one time or another complained about some aspect of Governmental procurement practices, usually with the implication that private enterprise could and would do it better if given the chance. Now we have the chance and it is important for many reasons that we live up to our claims.

The fourth aspect of our weapon system management policies is emphasis upon small business participation. Through the years our company has been able to place about 50% of its total purchase commitments with small business. As we get into these large weapon system programs, our percentage of direct procurement from small business will necessarily fall off sharply, because the two dozen or so firms that take on contract responsibility for major systems will most certainly have to be large companies.

This would be true regardless of whether the Government or private industry makes the procurement decisions. However, the work will fan out from these large companies to successive tiers of subcontractors, including many in the small business category. The fact is that qualified small business will certainly participate as much as it has in the past.

We are incorporating in all our purchase contracts certain clauses designed to encourage maximum procurement from small business. In those exceeding a certain value we are planning to ask that the various tiers of subcontractors report back to us on the extent of small business participation. We are taking these formal steps because it is national policy, as enunciated by the Congress, to insure the participation of small business in defense work. However our company, and I imagine the same will be true of most of our major partners in these projects, doesn't require any political or other pressure to utilize small business. Most successful large companies have developed a network of tried and proven small suppliers upon whom they rely for support.

Of course we will be able to deal directly with small business in our airframe structural subcontracting to a greater degree than in the systems area. Even here, however, the requirements will be such that most of the first tier value will have to go to relatively large organizations having the engineering and manufacturing capability to handle these programs of greater-than-average scope and difficulty. They in turn will spread the work.

Finally, we are determined to maintain careful cost stewardship in all phases of our weapon system management. Of necessity the development of advanced supersonic weapons like the F-108 and B-70 will be costly undertakings. The airframes, the engines, and each of the major systems will represent extraordinary technical advances. We believe that, with the cooperation of our industrial partners in these projects, the many development problems can be solved at minimum cost.

As weapon system prime contractor we intend to utilize all the techniques at our disposal to encourage efficiency and economy. In the bid stage we are undertaking not only to compare estimated total costs but to evaluate the individual cost elements making up the estimates in a careful effort to keep cost comparisons realistic. When the contractors are selected and the work gets under way, we will examine monthly cost reports from each major contractor, and these will include the latest estimates to completion.

In all probability we should be able to maintain the closest cost control in the brief history of weapon system contracting, because we have studied and tried wherever possible to improve upon the techniques employed on other weapon system contracts.

New UGL Test OK'd for Army Spec

More severe test developed by CRC to measure antiscoring properties of universal gear lubricants has been made a part of a proposed revision of Military Specification MIL-L-2105. Its use should assure adequate antiscoring protection for rear axles under present-day driving conditions.

Ordnance Impressed With L-42 Test Results

R. E. STREET, Office, Chief of Ordnance, Department of the Army, has this to say about the results obtained with the new test technique:

"The Ordnance Gear Lubricants Reviewing Committee has examined the results of over 100 duplicate L-42 tests.

R. E. Street

"We have been particularly impressed with the excellent repeatability achieved in these tests, realizing the difficult nature of cyclic loading tests. We have also been impressed with the fine reproducibility shown among the laboratories involved. The average repeatability on all programs showed the per cent scored area to be within 1 or 2% of the total contact area. The reproducibility differences were only slightly above this.

"Based on past experience, we think these results are outstanding for this type of cycling test."

ANTISCORING properties of universal gear lubricants under high-speed and shock-loading conditions can now be evaluated by means of a research technique developed by CRC at the request of Ordnance.

This technique (known as L-42), plus L-37 — a high-speed, low-torque and low-speed, high-torque test, which was developed last year (see *SAE Journal*, December 1957, p. 32) — have been made a part of a proposed revision of Military Specification MIL-L-2105, along with anticorrosion, thermal oxidation stability, and other new requirements.

With these revisions, MIL-L-2105 will now require tests for gear oils that represent operating conditions as these exist today for cars and trucks. The severe speed and torque conditions under which today's rear axles operate come from such causes as increased horsepower and increased loading in low gear due to the use of automatic transmissions.

L-42 takes care of these more severe conditions by requiring peak torques that are two to three times those of the previous test technique (L-19).

The new test technique is described in the recently released CRC report 330. The report also includes background material telling how the test was developed, together with data to establish its severity, repeatability, and reproducibility.

Conclusions

Test work on the new procedure was carried out in four laboratories. Using equipment of the same design, run under the same operating conditions, they reached the following conclusions:

- The severity level of the test technique has been

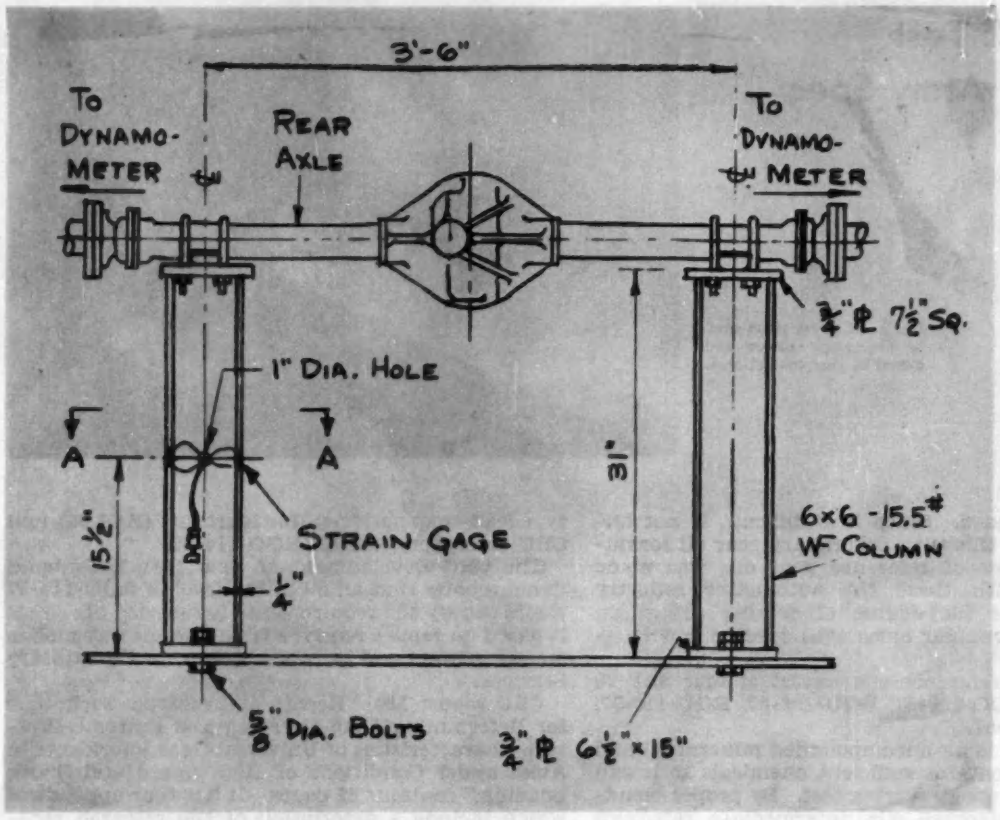


Fig. 1 — Typical mounting arrangement for L-42 test. Four electric resistance strain gages should be mounted, as shown, to give accurate torque measurements.

set at a level considered to be satisfactory for service fill in axles after break-in.

- The test technique appears to produce adequate repeatability and reproducibility with the reference gear lubricants.

- The spread between lubricants of different anti-scoring properties is satisfactory. However, because of the type of technique, the variables between gears, and the limited amount of experience with the technique, it is felt that more than one test run is desirable.

- As a final check on the validity of the test, runs should be made using reference oils RGO-108-57 and RGO-110-57, the results from which should be in the range of scoring shown in Appendix B (of CRC report 330) for the data to be assumed valid. It is recommended that these runs be made every 8–12 tests. If there is reason to suspect the results obtained, then these reference oils should be run at shorter intervals.

What Level of Scoring Protection?

Before work could be started on the new high-speed test technique, it was necessary that the automotive industry indicate the level of scoring

The CRC group that developed both the L-42 research technique described here and the L-37 technique is the Development of New Test Techniques Panel of the Motor Gear Lubricants Group. T. P. Sands, Monsanto Chemical, is leader of the panel. Other members are: W. C. Brandow, Lubrizol; **C. C. Colyer,** Standard Oil (Ind.); **E. P. Cunningham,** Monsanto Chemical; **R. F. Gasvoda,** Ford Motor; **Bain Griffith,** Ford Motor; **R. E. Harvie,** Chevrolet Division, GMC; **R. E. Hefner,** Dow Chemical; **W. A. Johnson,** Timkin Detroit Axle; **H. J. Korp,** Southwest Research; **L. W. Manley,** Socony Mobil; **D. F. Miller,** Chrysler; **L. J. O'Brien,** Dana; **R. E. Osborne,** Research Staff, GMC; **D. L. Powell,** Armour Research; **R. K. Smith,** Elco Lubricant; and **J. B. Stucker,** Pure Oil. Ordnance Project Officer: **N. L. Klein,** Office, Chief of Ordnance.

T. P. Sands

New UGL Test OK'd for Army Spec

. . . continued

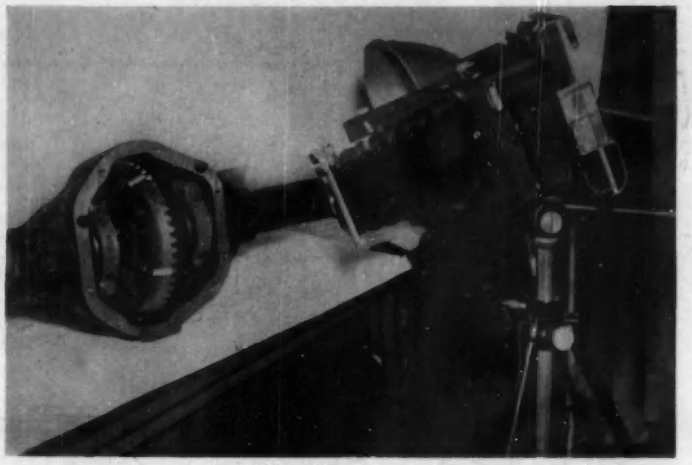


Fig. 2 — Camera setup used to photograph nature and extent of gear contact area.

protection needed. Since it is difficult, if not impossible, to do this with proprietary gear oil formulations, a series of reference gear oils was made available. With these the automotive industry could evaluate the degree of scoring protection needed for particular axles with specific test techniques.

These CRC reference oils consist of four SAE 90 grade oils: RGO-100-57, RGO-108-57, RGO-110-57, and RGO-115-57.

RGO-100-57 is an uncompounded mineral oil and RGO-115-57 contains sufficient chemicals so it can pass the most severe scoring test. By proper blending of the reference oils, intermediate reference levels may be obtained. RGO-105-57, for example, is obtained by blending 50% by weight of RGO-110-57 with 50% of RGO-100-57.

MIL-L-2105 oils (SAE 90 grade) have a scoring level between RGO-105-57 and RGO-106-57.

Data from one cooperating laboratory indicated an equivalence in scoring level between factory-fill-type lead-soap active-sulfur lubricant (SAE 90) and CRC reference gear oil RGO-114-57.

The CRC Development of New Test Techniques Panel reports that an oil of the level of RGO-110-57 would satisfy the requirements for service fill. This is based on replies received from various automobile manufacturers and has the approval of the Military Services.

CRC report 330, "Report of Research Technique for Determining Load-Carrying and Extreme-Pressure Characteristics of Universal Gear Lubricants in Axles under Conditions of High Speed and Shock Loading," contains 62 pages. It has four appendices which include a description of the research technique, test data, photographs of gears run under various test conditions, and typical oscillograph records.

To Order CRC-330 . . .
. . . on which this article is based, turn to page 6.

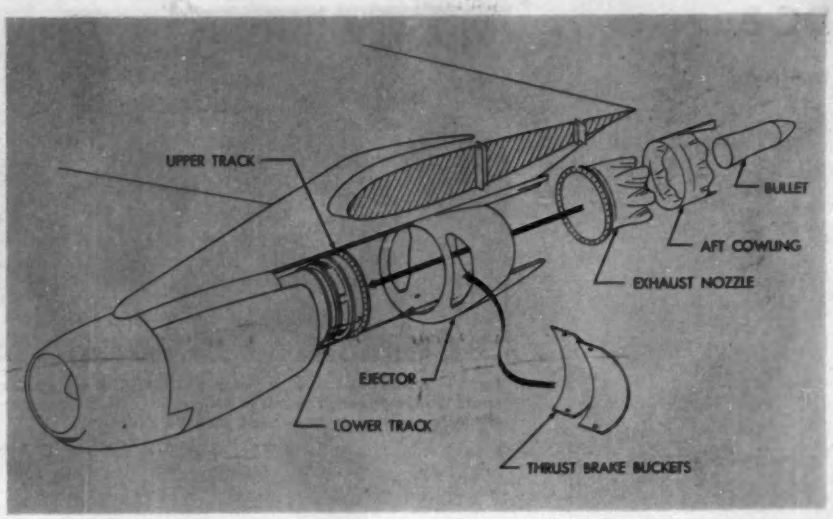
1958 SAE Journal Index Appears in this December Issue

AN Index of all technical articles published in the 1958 issues of SAE Journal appears on pp. 179–198 of this December issue. The Index covers all material published in the Journal during 1958, based on the following:

1. Papers presented at National Meetings.
2. Papers presented at Section Meetings, received at SAE Headquarters.
3. Round table and production panel reports received at SAE Headquarters.
4. Articles based on SAE Advisory Committee reports.

Every article is indexed by:

1. Authors' names. 2. Journal headline. 3. Subject headings.
(When the Journal article contains discussion, names of discussers are also listed.)



corrugated nozzle
retractable ejector
target-type brake

DC-8

90% sound reduction on take-off
40% thrust braking on landing

Based on paper by

L. R. Jordan and C. M. Auble

Douglas Aircraft Co.

A THREE-PART system supplies 9–12 db noise suppression and better than 40% reverse thrust in Douglas' new DC-8 jet transport. The system uses a corrugated suppressor followed by an ejector equipped with a target-type thrust brake. The db drop in sound level corresponds to a 90% reduction in sound energy.

selecting the suppressor

The corrugated suppressor design was chosen for the production design shown in Fig. 1 because it:

- Produced better than the desired sound level when combined with an ejector.
- Has low external drag.
- Is rugged in design and has no moving parts exposed to hot exhaust gases.

A multitube design was a close second but was not used because of its higher external drag. Adjustable flaps were completely eliminated when the desired noise suppression could not be achieved, even when an ejector was added.

The ejector actually serves two purposes. First, it increases the sound suppression and improves flow efficiency. Second, it provides a mounting place for the thrust brake.

how the suppressor was improved

To provide design data, a program was established to optimize the sound and thrust performance of corrugated nozzles. Results showed that best sound suppression came from nozzles that had:

- A large outer diameter at the exit plane.
- Lobes which increased in cross-sectional area at the exit plane with radial distance from the thrust axis.
- No fewer than 8 lobes.
- A small center body or "bullet."
- At least 90% of the exhaust gases exiting through the lobes. (The remaining gases exit through the annular passage near the bullet.)

Minimum thrust loss was achieved when:

- Few lobes are used.
- The nozzle cross-sectional flow area is constant or slightly convergent. (Convergence to the final flow area should take place rapidly in the final few inches of gas travel.)

In the design of the ejector, geometry was largely determined by installation considerations. However, tests indicated that in installations where some design latitude is available, optimum sound

DC-8

(continued)

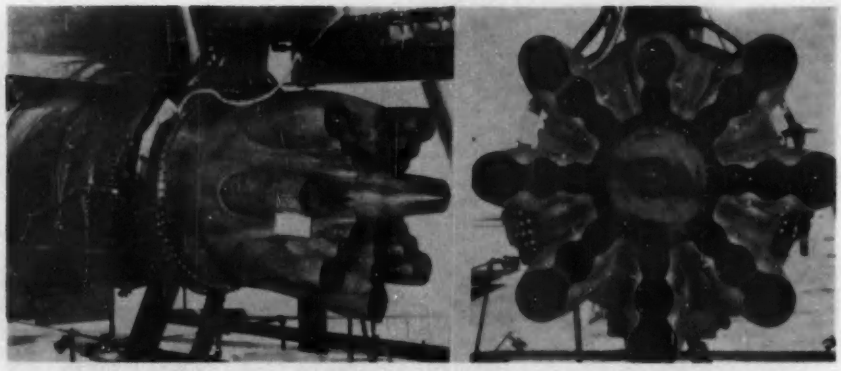


Fig. 1 — Production suppressing nozzle of the DC-8 has a triple bubble design, internal vanes, and radial struts to prevent distortion. It is made of 19-9 DL stainless steel. The top lobe is reduced in height to eliminate washing of the exhaust gas over the pylon.

and/or thrust performance is obtained when the ejector:

1. Is made as long as possible.
2. Internal lines are smooth and unbroken.
3. Exit diameter is equal to or slightly greater than the outer diameter of the nozzle.
4. Is as nearly cylindrical as possible.
5. Leading edge thickness is sufficient to eliminate separation in static operation.
6. Leading edge is placed slightly aft of the nozzle exit plane.

The advantage of adding an ejector to the corrugated nozzle is brought out in Fig. 2. Without the ejector, the nozzle can cut the noise 9–12 db, which was the design goal in the first place. The ejector not only improves the noise condition, but converts a thrust loss into a thrust gain.

selection of thrust brake design

A decision was made to use the target rather than the cascade type thrust brake for the following reasons:

1. The internal cascade thrust brake requires a seal between the tailpipe and the nacelle. This seal presents a formidable design problem, with some leakage in service being unavoidable. Leakage results in a thrust loss not experienced by the target type thrust brake.
2. The target type thrust brake is isolated from the engine by a nozzle which is choked when reverse thrust is required and thus has negligible effect on engine operation.
3. The internal cascade thrust brake has moving parts placed continuously in the hot gas stream. Furthermore, its position makes accessibility difficult. Maintenance problems are expected to be more frequent and difficult than with a target type thrust brake.

With a retractable ejector already in use with the sound suppressor, it is lighter and more reliable to mount the thrust target inside the ejector. A sketch of its operation is shown in Fig. 3.

During test work on this design, the following criteria were established:

1. Moderate aft sweep (9–11 deg angle — see Fig. 3) on the buckets in the braking position has little effect on the reverse thrust. Aft sweep was found to be desirable to stabilize the gas flow during the braking operation.

2. 1% of unblocked area in the ejector results in approximately 2% loss in braking thrust.

3. The length of the aft lip extension, which serves to turn the flow in a forward direction (see Fig. 3), has a relatively small effect on performance. The optimum length was found to be approximately one-third of the reference nozzle diameter.

4. Corrugated nozzles with large center bodies produce less reverse thrust than corrugated nozzles with small center bodies.

5. The ejector leading edge shape and geometry have little effect on reverse thrust.

6. The per cent of reverse thrust is relatively insensitive to power setting under static operating conditions.

7. This type of thrust brake has negligible effect on engine operation.

The performance of this thrust brake installation in an ejector is shown in Fig. 4. The curve shows that the reverse thrust decreases slightly as nozzle pressure ratio decreases. The airflow curves in Fig. 4 indicate that the thrust brake has negligible effect on engine operation over the entire operating range.

ejector operation and safety features

The ejector rides on two sliding carriage assemblies and is positioned fore and aft along the pylon track by a 5/16-in. steel cable. (See Fig. 5.) Power is supplied through a piston operated by the aircraft

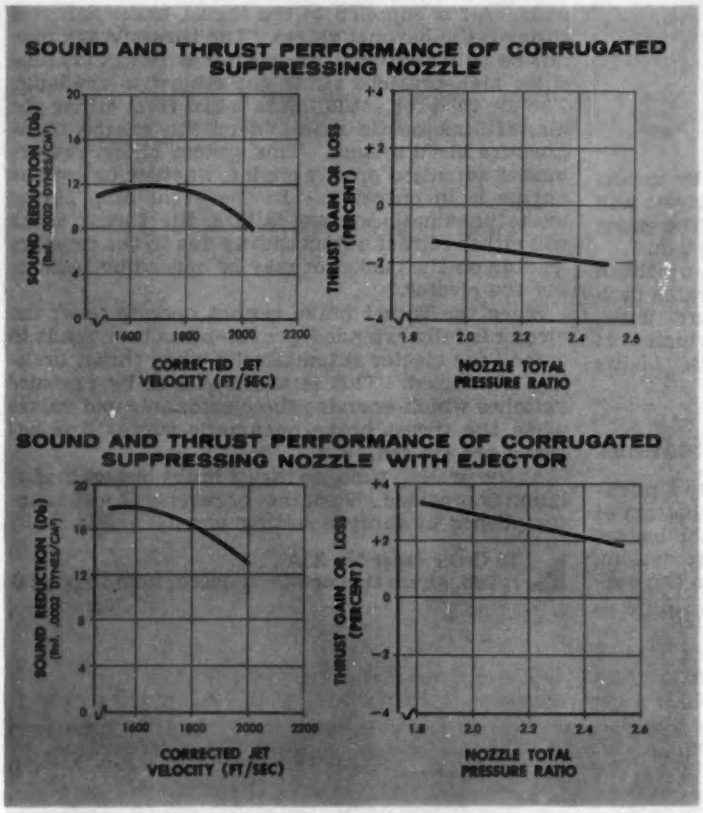

SOUND AND THRUST PERFORMANCE OF CORRUGATED SUPPRESSING NOZZLE
SOUND REDUCTION (Db)
CORRECTED JET VELOCITY (FT/SEC)
THRUST GAIN OR LOSS (PERCENT)
NOZZLE TOTAL PRESSURE RATIO
SOUND AND THRUST PERFORMANCE OF CORRUGATED SUPPRESSING NOZZLE WITH EJECTOR
SOUND REDUCTION (Db)
CORRECTED JET VELOCITY (FT/SEC)
THRUST GAIN OR LOSS (PERCENT)
NOZZLE TOTAL PRESSURE RATIO

Fig. 2 — A marked increase in performance resulted from the addition of an ejector to the corrugated suppressor nozzle. The moveable ejector also acts as a mount for the thrust brake.

hydraulic system. The actuator extends the ejector in three seconds and retracts it in six seconds. The ejector is held in either position by locking hydraulic fluid in the cylinder. Provisions are made for adjusting cable tension, cylinder stroke, and ejector position. Two bayonet type disconnect valves are fitted in the aft slide assembly. When the ejector is fully extended, these connect with valves in the pylon at the rear of the ejector track and thus supply air for the thrust brake actuator. A shock absorber is installed in the aft track assembly at the ejector stop to absorb impact energy in case of an actuating system failure. Latches are provided on the pylon track to prevent inadvertent extension in flight.

Emergency actuation is possible in case of a hydraulic system failure by means of stored high-pressure air. Air capacity is provided for one extension or retraction of each ejector. The system is cable operated from the cockpit.

A positive cam mechanism is incorporated which precludes ejector retraction with thrust brake buckets extended. This mechanism retracts the

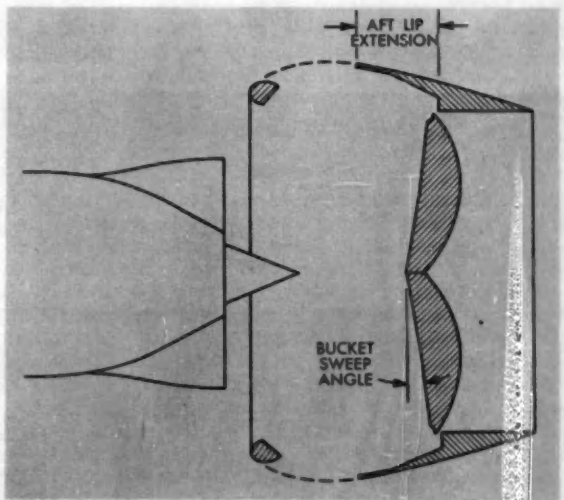


Fig. 3 — Cross-section of ejector thrust brake shows a moderate aft sweep. This helps stabilize the airflow, but has little effect on the reverse thrust.

DC-8

(continued)

buckets as the ejector is pulled forward by means of cam action between the upper bucket pivots and the track. This system operates only in the event of failure in the thrust brake actuating system.

The ejectors are operated by two overhead switches in the cockpit. One switch operates both outboard ejectors, the other the inboard units. These switches energize solenoid valves which port hydraulic fluid to the actuating cylinders. Lights in the cockpit indicate full extension.

thrust brake operation and safety features

The thrust brake buckets are actuated by a pneumatic piston and cylinder mounted at the bottom of the ejector. The piston is connected to the bucket lower pivots through a bell-crank linkage system. The system operates the buckets in one to two seconds. Air is supplied to the thrust brake actuator through the bayonet valves. The thrust brake may not be actuated until the ejector is fully extended since high-pressure air is not otherwise available. The air used for actuation is taken from either the aircraft pneumatic manifold or the engine high-pressure bleed system. This system allows reverse bucket actuation on any engine, whether or not the engine is in operation. In the event of a thrust brake pneumatic system failure, the thrust brake will either retract automatically due to the pressure loading on the bucket or may be opened by retracting the ejector.

Since the thrust brake cannot operate until the ejector is fully extended, provision has been made to extend the ejector automatically when thrust braking is selected. This is accomplished by pressure switches which energize the ejector solenoid valves when the thrust brake pneumatic supply line becomes pressurized.

At the present time, no thrust brake bucket modulation is provided. Variation of reverse thrust is accomplished by throttle setting.

To Order Paper No. 85A . . .
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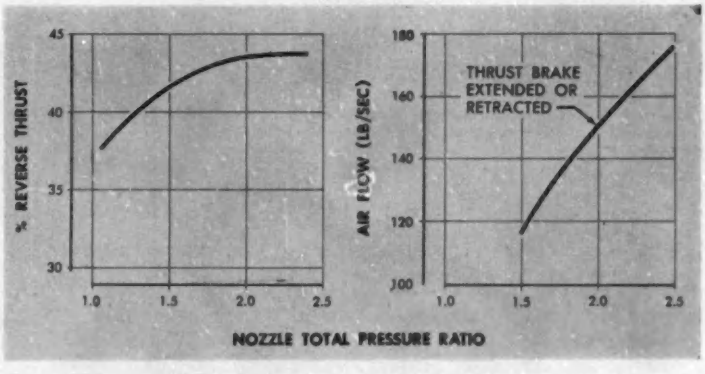

Fig. 4 — Thrust brake has little or no effect on engine performance. This is shown by the overlapping of the two airflow curves. The design goal of 40% reverse thrust is easily met at all normal nozzle pressure ratios.

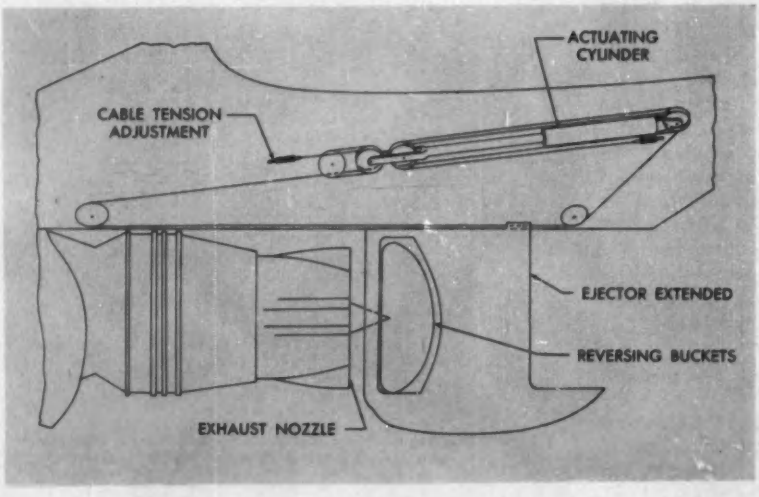

Fig. 5 — Ejector is powered by a hydraulic cylinder which operates off the aircraft hydraulic system. The thrust reversing buckets are air operated. The air lines are automatically disconnected until the ejector is fully extended.

A feature of the
SAE Nuclear Energy Advisory Committee

Radioactive Wastes . . .

. . . may be "locked" in ceramic for safe burial, if experimental process proves a success.

By C. W. Phillips
Ford Motor Co.

(A report to the SAE Nuclear Energy Advisory Committee)

USE of ceramics in a process now being developed to provide safe disposal of radioactive wastes is just one of the ways in which ceramics are aiding the nuclear power field.

With this experimental process, concentrated radioactive waste is absorbed on montmorillonite clay and then fixed by firing. The resulting stable solid can be buried without fear of eventual leaching and removal of the radioactive components by ground water before sufficient radioactive decay can occur.

Since fuel elements, moderators, and control rods all make vital use of ceramics, new ceramic materials and improved methods of fabricating ceramics are also being studied.

New Materials

The search for ceramics exhibiting suitable combinations of desirable properties for nuclear reactor parts is being accelerated by our increasing knowledge of the regularities encountered in the structures and properties of refractory compounds. This is making it possible to predict, with considerable precision, the properties of specific compounds . . . and thus develop ceramics that minimize such common disadvantages of ceramics as: low thermal conductivity, low thermal shock resistance, and low density.

Uranium dioxide is already extensively used as a fuel material. Uranium monocarbon and the uranium silicides — U_3Si and U_3Si_2 — have promising properties in this connection. When thorium becomes available as a reactor fuel, the dioxide form will undoubtedly be employed, either pure or in combination with uranium dioxide.

Solid moderator materials are usually based on graphite. Beryllium oxide can, however, be used either as a pure compound or in combination with graphite. Berylia has a very high thermal conductivity and therefore high resistance to thermal shock.

Many compounds can serve as control rod materials. Carbides and nitrides of hafnium and boron and the oxides of hafnium, gadolinium and samarium are also suitable. The question of thermal conductivity and thermal shock point to the possibility of advantageous use of the cermets of these compounds.

A real possibility also exists for the development of engineering ceramics having high melting point, inertness to atmospheric corrosion, and ease of fabrication, along with the tremendous advantage of ductility.

Encouraging results in this direction are coming from recent metallurgical work, which has greatly elucidated the details of atomic movements within ductile material during deformation. The process involves the relative motion of certain atomic planes by means of the movement of dislocations, a specific kind of defect universally observed in ordinary crystalline solids. The techniques and experience developed in this line of research have been carried over to ceramic studies. Thus, it has been shown that the same mechanism can result in macroscopic plastic deformation of as much as 20% in what are ordinarily considered brittle materials, such as magnesium oxide, lithium fluoride, and sodium chloride.

Fabrication Techniques

New methods of producing and controlling highly concentrated sources of energy — electron beam melting, high-energy, inert-atmosphere arc melting, and even solar furnace melting procedures — have made the production of very refractory materials possible. Hot pressing techniques now permit forming at temperatures of 2300 C and 10,000–12,000 psi. Extremely high pressures of the order of 1,500,000 psi are being used to manufacture diamonds and other very hard materials. Commercial fabrication of delicate structures such as honeycombs of aluminum oxide or magnesium aluminum silicate with wall thicknesses of 0.002 in. and lattice dimensions of 0.050 in. can be made. These materials appear promising as high-temperature heat exchanger components.

"Hot-Shot" Wind Tunnel Uses Arc Heating

Stored electrical energy drives a hypersonic tunnel at Mach 24 and 10,000 K

Based on paper by

Ronald Smelt and T. E. Turner

Lockheed Aircraft Corp.

Table 1 — Capacitor Storage System

Individual Capacitor Units:	
Capacitance, microfarads	7.5
Inductance, microhenries	0.36
Rated Voltage, v	20,000
Energy Stored, joules	1,500
Main Capacitor Bank:	
Number of Capacitors	320
Capacitance, microfarads	2,400
Inductance, microhenries	0.26
Rated Voltage, v	20,000
Energy Stored, joules	480,000
Peak Current[a], amp	1,000,000
Peak Power[a], kw	20,000,000
Rise Time[a], microsec	15
Discharge Time Constant[a], microsec	50
Charger Power Supply:	
Output Voltage, v	Variable up to 20,000 max
Rated Current, amp	1
Time to Charge Main Bank, sec	50
Primary	440 v, 3 phase
Trigger Circuit:	
Number of Capacitors	2
Energy Stored, joules	3,000
Charged by Above Power Supply	
Explodes Small Wire to Initiate Main Discharge	

[a] Assuming arc resistance = 0.02 ohms.

ARC-HEATING is Lockheed's answer to a hypersonic tunnel for Mach 15–25. The tunnel reaches these Mach numbers *and* does it with true stagnation temperatures.

The tunnel overcomes the basic problem of very high-speed wind tunnels. The problem is that the stagnation temperature of the tunnel air must increase roughly as the square of the speed, if correct simulation of temperature conditions around the test model are to be maintained. At a Mach number around 5–7, it becomes impractical to heat the supply air by heat transfer surfaces that are hotter than the required stagnation temperature. Even the recently developed pebble-bed heaters only operate around 4000 F.

Arc-heating the air just before it is expanded into the tunnel test section also builds up the pressure required to drive the tunnel. As a result, the initial pressurization can be low for the speeds expected. Heating of the tunnel walls is the only limitation of the system. This can be overcome by restricting the duration of run. In practice, this means flow durations of the order of 1–10 millisec. This time duration is long enough to measure critical temperature rises on the model.

How the Tunnel Operates

A capacitor bank discharges through two electrodes placed inside an air chamber. The resulting high-pressure and high-temperature air then expands into a vacuum chamber. In so doing it passes through a 24-in.-diameter tunnel test section.

The capacitor has an energy storage of 480,000

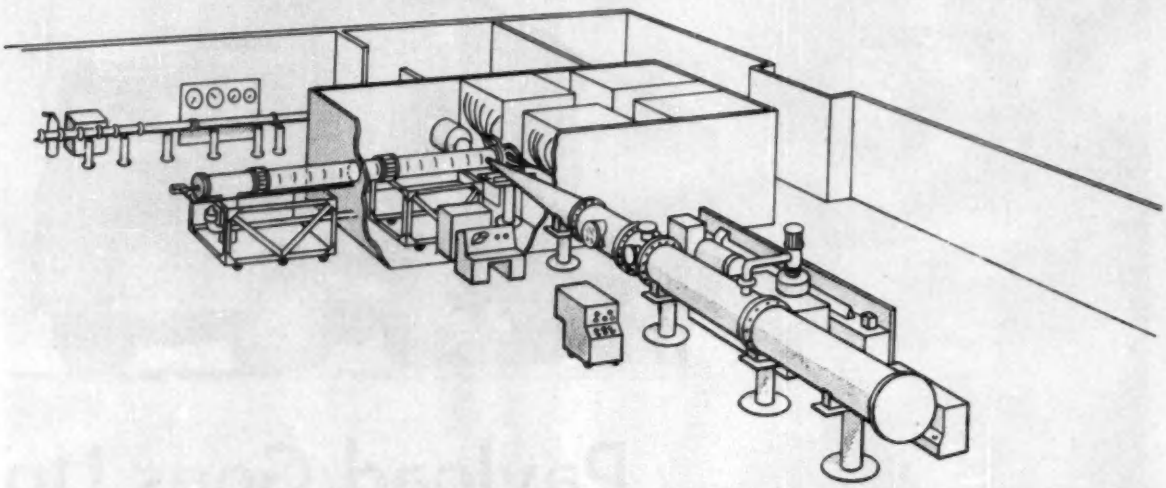

Fig. 1 — Arc chamber and capacitors are enclosed in a 3/16-in. steel room in Lockheed's hot-shot tunnel. The high-pressure high-temperature air is expanded through a conical nozzle (half-angle = 2.9 deg) to a cylindrical test section. The air is caught in a vacuum tank that is evacuated to a pressure of one micron. An experimental shock tube tunnel is located at right angles to the main tunnel. The cost of the hot-shot tunnel was: energy storage system — $36,426; tunnel — $34,421; instrumentation — $33,896. The experimental arc-driven shock tube was $1360.

joules. It can discharge this energy in 50 microsec because a high-voltage low-capacitance system is used. The ratings of this electrical storage system are given in Table 1.

The air heated by the discharge of the capacitors can reach 10,000 K. The walls of the container are protected by a thin layer of nylon. It is believed that nylon works to protect the steel chamber in the same way fiber glass does in the ballistic missile nose cone problem. The electrodes and tunnel throat are made of tungsten to minimize erosion and introduction of metal particles into the airstream. The remainder of the tunnel is mild steel.

The high temperatures also introduce ionization and dissociation of the air. In the short trip to the test section, it is possible that the air has not returned to a normal state. Further complications come from the fact that the dissociation did not take place in a rarefied atmospheric condition similar to the state of the upper atmosphere. Hence, it is necessary to calculate the molecule-to-molecule forces by appropriate equations of state. This all makes calculation of the conditions in the test section difficult. These calculations are necessary, though, because it is easier to measure gas properties in the arc chamber than in the test section.

The performance of the tunnel is given in Table 2 and a sketch of the overall layout in Fig. 1.

Future High-Speed Tunnels

A development under study is a modified shock tube and magnetohydrodynamic tunnel.

The present shock tube tunnels use a combustion process to form high-strength shocks. These shocks are passed through an air chamber and rapidly heat the supply air. The only problem is that high speeds and temperatures cannot be achieved together. Using an arc instead of a combustion process will give high driving temperatures and stronger shocks. These same high temperatures will ionize some of the air and make it possible to accelerate it with a magnetic field. The magnetic field will probably be generated by the same flow of current used to strike the arc.

To Order Paper No. 84A . . .
. . . on which this article is based, turn to page 6.

Table 2 — Hot-Shot Tunnel Operating Conditions

	Range	
	Lower Limit	Upper Limit
Initial Conditions:		
Energy Input, joules	Variable up to 480,000	
Chamber Air Pressure (cold), psi	500	to 2,000
Nozzle Throat Diameter, in.	0.05	to 0.200
Arc Chamber Conditions after Discharge:		
Stagnation Temperature, K	2000	to 10,000
Peak Pressure, psi	6000	to 38,000
Test Section Conditions:		
Velocity, fps	8000	to 22,000
Mach No.	10	to 24
Altitude Simulation, ft	140,000	to 240,000
Reynolds No/ft	3000	to 1,000,000
Running Time, millisec	10	to 34

Based on paper by
B. C. Harris White Motor Co.

Payload Goes Up with Plastic Truck Cabs

USING FIBER GLASS reinforced plastic as a material for making truck cabs provides certain advantages:

1. It is light in weight. A piece of fiber glass reinforced plastic 12 in. × 12 in. × 0.010 in. weighs 0.90 lb. A piece of 20 gage steel of the same size weighs 1.5 lb. And aluminum in a like size and 14 gage weighs 0.93 lb. The lighter the cab the lighter the truck and the more the payload that can be carried.
2. It has greater elasticity than either steel or aluminum. Both metals bend easily when fiber glass reinforced plastic retains its shape. The cost of manufacturing a cab of fiber glass is higher than making one of steel. However, the tool cost is considerably lower. Furthermore, more intricate shapes can be made without fear of tearing or having objectionable springback because parts are molded instead of being stamped. This means that fewer parts are necessary to make a cab.
3. The *K* (thermal conductivity) factor of fiber glass is such that it is warmer in winter than metal and does not absorb heat in the summer as metal does. Fiber glass also is softer than metal and isn't as resounding. Squeaks are practically unheard of — adding to driver comfort.

Among the other virtues of fiber glass are its nonrusting qualities and the ease with which it can be repaired.

A truck must be of a cab-over-engine tilt design to give the largest amount of loading space and still provide easy servicing. It must be wide and long enough, however, to provide driver comfort and yet clear all space needed for the engine.

An engine compartment running longitudinally through the center of the cab is characteristic of a cab-over-engine arrangement (Fig. 1). The amount of space this occupies must be kept to a minimum so the driver and passenger will not be hampered. By making this compartment of fiber glass, intricate contours and ribbing can be used, hugging the engine parts more closely, and thus giving the driver more space. Furthermore, it is made in one piece which adds strength and rigidity to the cab and insures against the entrance of fumes and air.

Outside dimension of the cab runs 50 in., front to rear. All required mechanical units are completely within the confines of this dimension.

Thick-door design (Fig. 2) provides greater strength and sufficient space for electrical vent-window mechanisms. Aluminum extrusions line the upper portions of the doors. This provides greater strength in a small section, and creates the groove for the glass run channel and the door seal. Further, it simplifies the molding of the door parts. By removing the entire extrusion, the glass and ventipane can be readily replaced.

Oddly enough, the two doors are not alike. The left-hand door forms the rear quarter panel and extends around the rear left-hand corner of the cab. This design makes easier getting in and out of the cab.

The front of the cab features a large curved windshield. Easy-eye glass copes with the heat problem presented by exposing so much glass area to the sun. The windshield is in two sections to facilitate installation and lessen the cost of replacement.

The fenders are made of fiber glass. This insures that no rusting will occur. The grille is a perfo-

Fig. 1 — Fiber glass truck cab has an engine-covering compartment made of fiber glass. Intricate contours and ribbing hug the engine parts closely giving the driver more space. In addition, the one-piece cover adds strength and rigidity to the cab.

Fig. 2 — Fiber glass cab has thick-door design for greater strength. The two doors are not alike, however. The left-hand door forms the rear quarter panel and extends around the rear left-hand corner of the cab. This makes it easy for the driver to get in and out of the cab.

rated aluminum sheet with a fiber glass frame. This can easily be removed for inspection or service on the radiator.

The mounting of the cab posed the greatest design problem (Fig. 3). The stresses and strains that cab mounts are subjected to are intense. To insure cab life and to isolate distortion of the cab, an underframe or platform is used to support the cab. The underframe is made of hi-tensile aluminum extrusions and is bolted to the floor and the front and rear panels of the cab at 49 places. When in place it is actually part of the cab structure. To this underframe the cab mounting brackets are attached. This perhaps is overdesigned, however, it does offer a satisfactory method of attaching the cab to the chassis.

A crossmember in the front part of the underframe is tubular to give torsional stability. This tube is also used as a cowl bar for the cab structure and a radiator surge tank as well, thereby saving weight.

Small problems have developed due to the cab being made of fiber glass. The truck being diesel powered has a stack or side exhaust. The pipe runs so close to the cab it was feared that it might burn the cab. The fiber glass reinforced plastic will not support combustion but it could char. To cure the trouble a polished stainless steel panel was fastened to the cab to reflect the heat.

Also because fiber glass doesn't conduct electricity, provision must be made to ground the instruments and lights by other means.

Care must also be taken not to expose fiber glass to points of wear as it is poor from an abrasion standpoint.

Fig. 3 — Hi-tensile aluminum extrusions form the underframe which supports the cab. The underframe is bolted to the floor and front and rear panels of the cab. Note the tilt cab, cab-over-engine design.

To Order Paper No. 100A . . .
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Air Conditioning

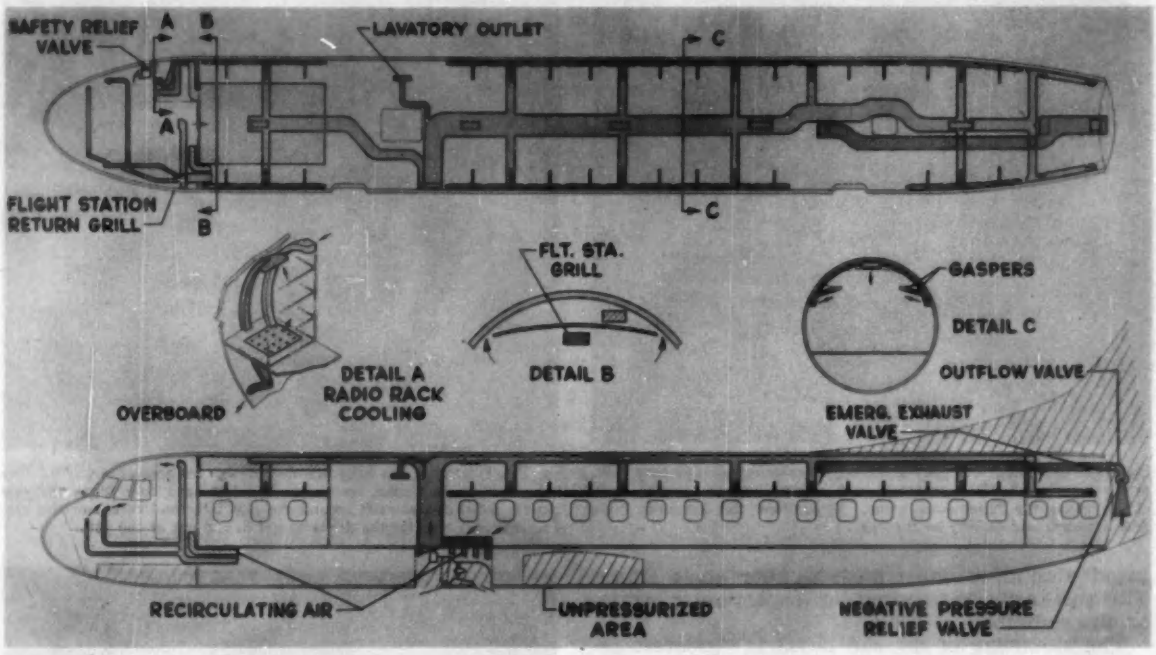


Fig. 1 — Supply air from the overhead duct is carried by 13 lateral ducts to the outlet manifolds located in the wall on either side of the cabin just below the hatrack and to the gaspers located in the hatracks.

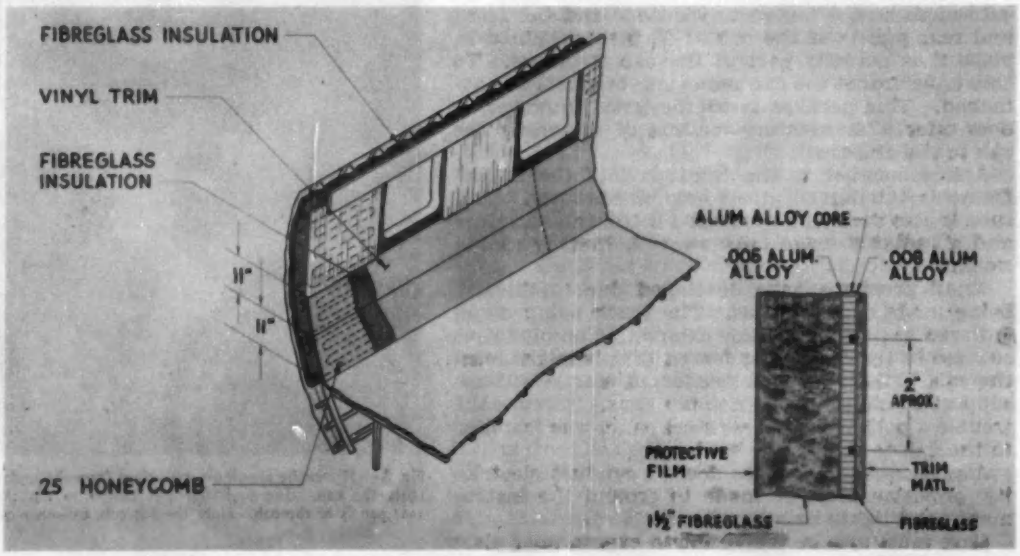


Fig. 2 — Construction of the Lockheed Electra electrically heated radiant sidewall panels, which eliminate cold surfaces close to the seated passengers.

the Lockheed Electra

Based on paper by

J. G. Krisilas and E. S. McCarthy

Lockheed Aircraft Corp.

PASSENGERS on the Lockheed Electra will be cooled comfortably and quietly by a single air supply duct and warmed by radiant panels in the sidewalls.

Given an opportunity to start from scratch to produce an air conditioning system which would perform in superior manner, certain characteristics of the Electra had an important bearing on the design decisions in configuration of the system. Salient points include:

1. Low engine compressor bleed airflow available with high penalties associated with its use.

2. Constant-speed engines resulting in the availability of large quantities of essentially constant-frequency electrical power.

3. Medium range with many short flights and short ground times in certain airline operating patterns.

4. Engine pad power available for air compressor drive limited to 80 hp.

cabin air distribution

To gain a maximum freshness effect the supply air is introduced to the cabin through low velocity outlets located in the immediate vicinity of the passenger's head. Use of electrically heated radiant panels in the walls and floor eliminate cold surfaces close to the seated passenger and, by raising these surfaces above cabin air temperature, heat losses from the occupied cabin are made up by a combination of convective and radiant heating. The use of radiant surfaces thus permits the cabin air supply to be used only to meet ventilation requirements during heating and is supplied therefore at a temperature equal to cabin temperature to insure minimum air temperature gradients in the cabin.

Exhaust air is collected at the ceiling and discharged overhead, carrying with it smoke and other contaminants. Air for the recirculation system is collected near the floor. Individual air outlets, commonly referred to as "gaspers," are provided at each passenger seat. A separate gasper supply is unnecessary since the temperature of the supply air is always maintained at or below cabin temperature by means of the automatic temperature control system. During cooling operation in warm weather, the supply air temperature from the gaspers will be

Table 1–Steady-State Heating Performance

Flight Condition	Compartment	Ambient Temperature, F	Compartment Temperature, F	Required Capacity, kw	Total Available Capacity, kw
Ground (full recirculation)	Flight station	– 5	75	3.9	10.0 (duct heater)
	Cabin	– 5	75	5.9	11.3 (radiant panels)[a]
Ground (15 lb/min fresh air)	Flight station	– 5	75	9.0	10.0 (duct heater)
(50 lb/min fresh air)	Cabin	– 5	75	23.0	30.0[b]
30,000-ft. cruise with	Flight station	– 60[c]	75	5.6	10.0 (duct heater)
8000-ft cabin	Cabin	– 60	75	7.6	9.7 (radiant panels)[d]

[a] The 11.3 kw is composed of 7.1-kw radiant wall capacity plus 4.2-kw required input power to maintain the floors at 80 F (7.8 kw is available, but power input to floors is limited by the required floor surface temperature). Since the supply air is maintained equal to cabin temperature, and since sufficient heat of compression is available from the cabin compressors to heat the incoming fresh air, the cabin duct heater is not required.

[b] Combined total of radiant panels plus 18-kw duct heater.

[c] At normal cruising speed, the corresponding skin temperature is – 40 F.

[d] The 9.7 kw is composed of 7.1 kw for the radiant wall panels plus 2.6 kw for the floor panels (with surface temperature limit).

Air Conditioning the Lockheed Electra

. . . continued

below cabin temperature. The combination of radiant panels and limited supply air temperature eliminates need for an independent gasper supply system.

There are three advantages accruing from this arrangement:

1. A common ducting system can be used for the main cabin supply and for the individual gaspers at a substantial saving in weight.
2. A relatively high pressure gasper supply system is not necessary to minimize gasper supply ducting size and insure proper operation with few or many outlets open.
3. The gasper noise problem vanishes.

fresh air flow

An almost constant volume rate of airflow is maintained through the cabin distribution system by a 2000-cfm fan driven by a 3-phase induction motor. In normal operation the ratio of fresh air from the engine-driven compressor to recirculated cabin air from the return system is approximately two to one. During other modes of operation, that is, with one or both compressors inoperative, or with auxiliary ventilation operation, the decrease in fresh air is made up with an additional amount of recirculated cabin air, thus keeping the same total volume airflow. The return for the recirculated cabin airflow is located in the main cabin in the lower wall near the floor on the right side. A check valve is included to prevent reverse flow during full auxiliary ventilation when the ram pressure exceeds the fan capacity. The supply air flows from the evaporator through the main riser on the left side of the cabin to the overhead distribution duct running fore and aft in the cabin ceiling, as shown in Fig. 1.

Air is exhausted from the cabin through the aft-mounted outflow valve used for cabin pressure control and the radio rack and toilet exhausts. The radio rack equipment is cooled by the air drawn from the ceiling of the forward cabin compartment. This air is ducted to the bottom of the radio rack and percolates up through the electronic equipment. After cooling the equipment the exhaust air is ducted to the overboard exhaust located below the cabin floor.

The flight station flow system is similar to the cabin system. A 400-cfm fan circulates a mixture of fresh and recirculated air, a mixture of auxiliary ventilation air and recirculated air, entirely recirculated air, or entirely auxiliary ventilation air, depending on mode of operation.

operation of heating system

An 18-kw electric duct heater is located in the cabin supply system immediately upstream of the freon evaporator. It is constructed of 18 extended surface heat exchanger elements with an applied ceramic-coated electrical conducting material on one side of the elements. Protection is provided by an overlay of epoxy insulating film. Modulation is accomplished in steps of 3 kw, and at a full electrical load at sea level a 28 F temperature rise is obtained for the supply air.

A similar duct heater of 10-kw capacity is provided to heat the flight station. Modulation is done in steps of 1 kw and at sea level the air temperature rise at maximum electrical output is 79 F.

Use of electrical power for heating eliminates conventional combustion heating systems and their associated troubles such as fuel, air, and ignition controls and altitude ram air requirements. It also provides a more flexible configuration of light

modifications in

The Lockheed Electra cooling system was described at length in the SAE Journal, February, 1958. Development testing since revealed this system to be unpredictable in behavior and unstable in certain phases of operation, but pointed the way to improvement by using a different method of evaporator modulation.

Here are described the problems met with the original system and the distinguishing characteristics of the substitute method.

★

The Electra's freon vapor cycle refrigeration system was initially the conventional constant superheat type with thermostatic expansion valves metering the liquid freon from the condenser to the evaporators. Cooling was modulated by varying the saturation pressure of the freon in the evaporators by back pressure regulators located in the suction lines between the evaporators and the compressor and receiving their actuating signal from the temperature control system. As cooling demand decreased, the evaporation temperature of the freon increased while maintaining a constant superheat at the evaporator discharge.

Test of the system soon indicated the impossibility of stable control under all conditions. The problem areas were as follows:

1. Accumulation of large amounts of freon in evaporator during low load at elevated evaporator pressure. When the tem-

weight which permits location near the areas being heated.

The panels for both walls and floor are similar in construction (Fig. 2). They are made of aluminum honeycomb filler sandwiched between two aluminum plates having aluminum braided resistance wires buried in the honeycomb just inside the outer plate. The wire is spirally wound on a thread of dielectric material to prevent breakage when the panels are deflected. The electric floor panels are located throughout the cabin except in high traffic areas; the wall panels are located below and between the windows. Rating of the panels is 20 watts/ft². Cargo floor panels maintain a minimum temperature of 40 F in the cargo compartments and their rating is 61 watts/ft². The summary of steady-state heating performance is shown in Table 1.

thermal insulation

The Electra is insulated thermally and acoustically with 0.60 lb/ft³ density Fiberglas insulation enclosed either in a Mylar film or vinyl-coated Fiberglas cloth. Thickness ranges from 1½ in. in the flight station up to 3 in. on the cabin fuselage walls, and to 3½ in. beneath the cabin floor.

Most of the supply ducting in the pressurized area, and the return ducting, are insulated with 1-in. Fiberglas batts enclosed in Mylar. Overhead supply ducts have 2½ in. of insulation on top, 1 in. on both sides, and ½ in. on bottom. Ducting from

electra refrigeration system

perature controller subsequently demands increased cooling (lower evaporator pressure), stored freon liquid is drawn into compressor causing prolonged overcurrent operation. Accumulation in either evaporator prevented proper operation of the remaining evaporator because low condenser freon liquid level resulted in gas ingestion into the liquid lines.

2. Inability to maintain dry, superheated freon gas at compressor inlet with reliability. The small operating forces on the thermostatic expansion valve (due to low-pressure characteristics of F-114) were inadequate to close the valve tightly and leakage occurred into the evaporators. Moreover, the slow thermal response of the sensing bulb located in the exit header of the evaporator was inadequate for the required rapid response characteristics of the system.

3. Inability to maintain evaporator pressure control at low condensing pressures. This was due to the servo pressure being insufficient (at low condensing pressures) to control the back pressure regulators properly.

4. Instability of the surge bypass valve and a tendency for it to open during some regimes of operation.

5. Inconsistent control of superheat due to poor expansion valve regulation, which resulted in general loss in performance and prevented modulation toward zero cooling.

Subsequent testing revealed the possibility of gaining a stable and much improved performance by using a different method of evaporator modulation, referred to as "variable" superheat. This system has the following characteristics:

1. The superheat of the vapor at the evaporator exit is varied with load while maintaining a constant minimum evaporator pressure. This is done by substituting direct operation of electrically actuated liquid throttling valves for the thermostatic expansion valves. These valves are positioned directly by the cabin and flight station temperature control systems.

2. Evaporator air side frost is prevented by limiting the minimum evaporator pressure with a back pressure regulator which replaced the modulating back pressure regulators of the constant superheat system.

3. Excessive compressor motor current limit override control reduces flow of refrigerant by closing the liquid throttling valve at the cabin evaporator.

4. Quantity of freon in evaporators tends to remain constant since evaporator heat transfer surface is used to obtain the required increased superheat at low loads.

5. No minimum superheat control is required since testing showed the compressor to be extremely tolerant of ingested liquid.

6. Minimizing the amount of freon in the evaporators eliminates the tendency for large current surges to occur in the transit from low load to high cooling loads. Since the liquid throttling valves are controlled directly by electric actuators, sufficient forces are available for tight closing and sealing of the valves when no freon flow is required.

7. The thermal response of the system is rapid and stable.

Air Conditioning the Lockheed Electra ... continued

the fuselage, cabin exhaust air ducts, and radio rack cooling air ducts are uninsulated.

cooling system design philosophy

The cooling system combines vapor and air cycles. The 10-ton capacity freon system was dictated by the requirement for steady-state cooling of a fully occupied airplane on the ground. This capacity is also available for rapid precooling prior to passenger loading. All vapor cycle ground cooling is available when a ground electrical source is connected to the airplane, engine operation being unnecessary. Another major advantage of the freon system is the elimination of filter-type water separators and non-icing controls normally used with air cycle equipment. Encounters with fog in the discharge duct of the air cycle turbines are corrected by a device which opens the turbine bypass valve slightly, thus dissipating the fog. Effective and simple humidity control is gained by condensing moisture on the cold evaporator surfaces, with the condensed moisture subsequently drained overboard. The summary of the steady-state cooling performance is shown in Table 2.

To Order Paper No. 87C ...
... on which this article is based, turn to page 6.

Table 2–Steady-State Cooling Performance

Flight Condition	Compartment	Ambient Total Temperature, F	Compartment Temperature, F	Required Capacity, tons	Total Available Capacity, tons
Ground	Flight station	100[a]	80 (28% RH)[b]	1.25[c]	1.7 tons[d]
	Cabin	100	80 (28% RH)	5.3	8.3 tons[d]
Cruise — 15,000-ft flight altitude	Flight station	67	80 (20% RH)	0.6	2.2 tons[e]
	Cabin	67	80 (28% RH)	3.2	3.9 tons[f]
Cruise — 30,000-ft flight altitude	Flight station	15	75 (4% RH)	0	1.9 tons[g]
	Cabin	15	75 (12% RH)	1.4	1.5 tons[f]

[a] Solar load produces an average skin temperature of 123 F for an unpainted fuselage.
[b] RH = relative humidity.
[c] Sensible plus latent requirements.
[d] Freon system refrigeration only; design point for freon system.
[e] Air cycle capacity of 0.5 tons plus 1.7 tons freon system capacity.
[f] Available air cycle capacity only; does not include 8.3 tons of available cooling from freon system.
[g] Air cycle capacity of 0.2 tons plus 1.7 tons freon system capacity.

Optimum cruise flight conditions are available in . . .

3 VTOL Speed Ranges

Based on paper by

W. Z. Stepniewski Vertol Aircraft Corp.

THREE speed ranges offer the most promise for VTOL aircraft if thrust requirements for cruise and take-off are to match. The ranges are centered around Mach numbers of 0.65, 0.8, and 2.0+. Here there is a chance to overcome the high thrust needed for hovering by use of bypass augmentation, special hovering jets, or favorable ground effects.

M = 2.0 offers particular promise as the ratio of take-off thrust to cruise thrust at 30,000 ft can drop as low as 2.65. In such a case, the use of special hovering jets may be the best way of making up the thrust difference while still using an optimum wing for cruise condition. The condition becomes even more favorable at higher altitudes. For example: at 60,000 ft cruise the ratio may drop to unity.

M = 0.8 requires thrust augmentation ratios above 4.0 if optimum conditions at cruise are to be met. The jet engine is still competitive at this forward speed. For a 30,000 ft cruise design altitude, the jetstream (assumed 2000 fps) would have to be converted to a downwash velocity of 360 fps with a bypass thrust generator loading of 310 psf. This means that 31% of the wing area would be consumed if a fan were buried in the wings. For a 10,000 ft cruise VTOL aircraft, the entire wing would be taken for an augmenting fan. In such a case, it is more efficient to increase the output of the powerplant and step-up the fan loading than it is to increase the size of the wing.

The thrust augmentation systems for the low-speed range will continue to center around propeller-driven aircraft.

To Order Paper No. 95C ...
... on which this article is based, turn to page 6.

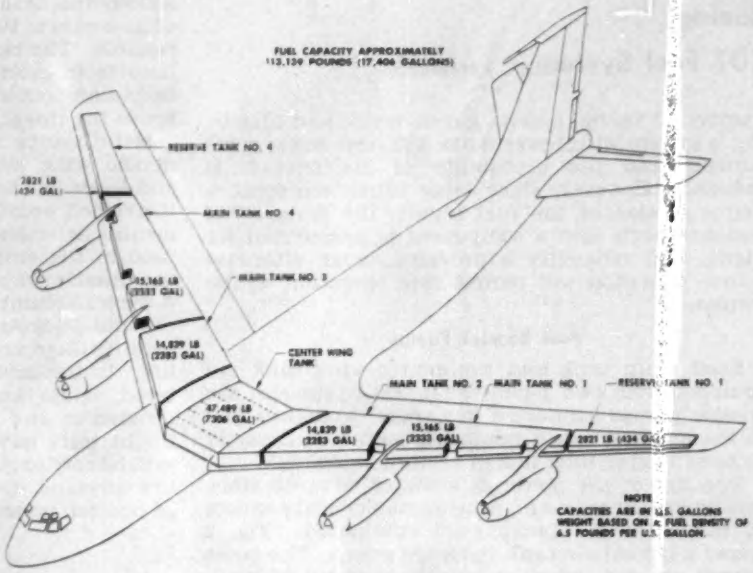


Fig. 1 — Relative size and location of the seven fuel tanks of Boeing 707 jet.

Boeing 707 Fuel System

Simplicity of design proves major factor in reliability.

Based on paper by

E. J. Osols

Boeing Airplane Co.

SIMPLICITY, reliability, and safety were the objectives sought in designing the fuel system of the Boeing 707. Early in the stages of designing, detailed objectives, based on service experience of other multi-engine jet aircraft, were documented as a guide for reaching the goal. Some of the primary objectives were to:

- Design a system simple to construct, maintain, and operate, consistent with safety and reliability requirements.
- Use service-proved components where feasible.
- Design so as to avoid the probability of malfunction due to human errors in operation and maintenance.

Arrangement of Fuel Tanks

Range and payload having established the quantity of fuel needed, the first consideration was to locate the tanks and determine their number. The wing inspar area was selected since sufficient volume was available. The fuel weight could be used to reduce wing bending moments, plumbing between tanks and engines would have a minimum length, and the fuel could be best isolated from the passenger cabin.

Seven tanks (four main, two reserves, and a center wing tank) were decided upon as giving the optimum number after studying fuel system management, center of gravity control, structural efficiency, and system reliability. Each main tank provides a completely independent, uninterrupted supply for its engine during the critical times of flight such as take-off and landing. The reserve tanks in each outboard wing are used primarily to reduce bending moments, while the center wing tank serves to control center of gravity. Fig. 1 shows the relative size and location of tanks.

Since each tank usually requires about the same

A DESCRIPTION of the 8-tank fuel system of of the DC-8 appeared in the November issue of the **SAE Journal** in the article, "DC-8 Fuel System Is Independent of Auxiliary Power," by M. A. O'Connor and W. B. King, Douglas Aircraft Co., pages 32-35.

Boeing

707 Fuel System . . . continued

number of valves, pumps, gages, vents, and plumbing, a system with fewer tanks will have fewer components and the probability of malfunction is reduced. However, since large tanks represent a major portion of the fuel supply, the system was designed such that a component is unessential for flight, dual reliability is provided, or an alternate course of action will permit safe operation of the airplane.

Fuel Booster Pumps

Each main tank and the center wing tank are equipped with two 3-phase, 115/200-v, 400-cps, a-c booster pumps connected in parallel to deliver fuel to the engines. Each pump has sufficient capacity to meet engine inlet design requirements.

The use of a-c power is a major advance since rotating shaft seals and brushes, the primary causes of failure of d-c pumps, are eliminated. Fig. 2 shows a typical a-c tank-mounted pump. The boost pumps are connected electrically directly to main busses and diversified so that loss of one main bus will not result in loss of more than one pump per tank. Direct control by a separate 3-pole switch for each pump is used throughout.

Inlet screens were removed from the pumps and installed in the airframe structure to permit the use of increased total area to guard against icing, to avoid hazardous secondary electrical paths to ground, and to provide additional protection from debris. Approximately 80 sq in. of No. 8 and No. 4 mesh screen are used for each main tank pump. Pressure switches monitor pump performance.

Plumbing Improvements

Past experience shows fuel line couplings and fittings under pressure to be the major cause of serious fuel leaks. Since minor internal leakage is of no concern, tubing was routed inside tanks where feasible. The basic wing structure also protects fuel lines from external damage. Safety wiring of fittings and couplings inside the tanks is used to improve the integrity of the coupling.

Metal tubing routed on the neutral bending axis of the wing structure, designed to accommodate end loads, is used throughout. Nonmetallic tubing is avoided because of its susceptibility to environmental deterioration. Only four flexible hoses are used in the entire system. These are installed at the disconnect point between the strut and engine. A typical plumbing layout is shown in Fig. 3.

Metal-to-metal couplings and O-ring-sealed bulkhead fittings are used exclusively for long service life. In the interest of pump out performance, mitered bends and right angle elbows have been avoided in the main tank to engine fuel system. Flight tests have proved the possibility of getting satisfactory engine performance throughout the entire airplane operational envelope without the aid of booster pumps during emergency.

Fuel Control Valves

A total of 10 cockpit operated open-closed valves manage the entire system. Each engine is provided with one shut-off and one manifold valve to control flow and permit feeding any engine from any tank, and a reserve tank valve controls gravity transfer. Motor-operated, 28-v, d-c slide valves were chosen for this to permit battery operation in emergencies. The valve represents a refined type of one in proved service for 15 years, its most significant improvement is the use of a sealed actuator and motor housing. All control valves are protected by structure against damage in the event of a gear-up landing, frontal impact, or a strut being separated from the airplane.

The center wing tank is isolated from the cross-feed manifold by high spring-load check valves. Its fuel pump pressure will automatically open

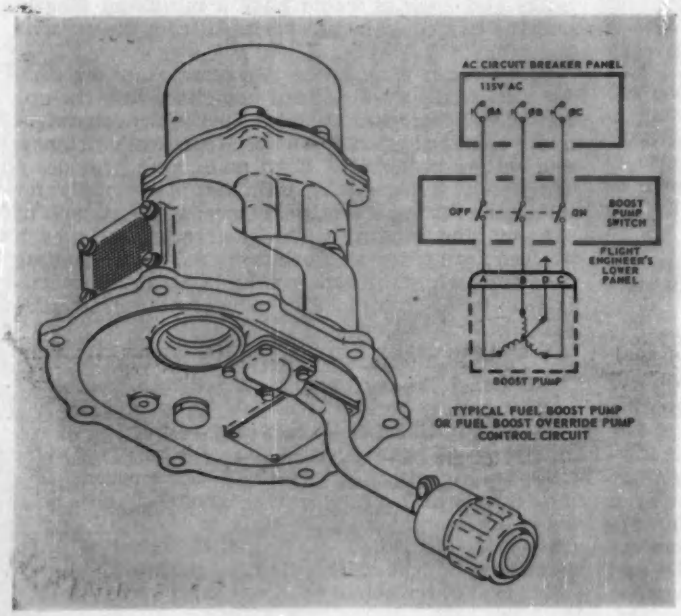


Fig. 2 — Each main tank and center wing tank is equipped with two booster pumps to feed fuel to the engines. Use of a-c power enhances pump reliability by eliminating the rotating shaft seals and brushes which are the primary cause of d-c pump failures.

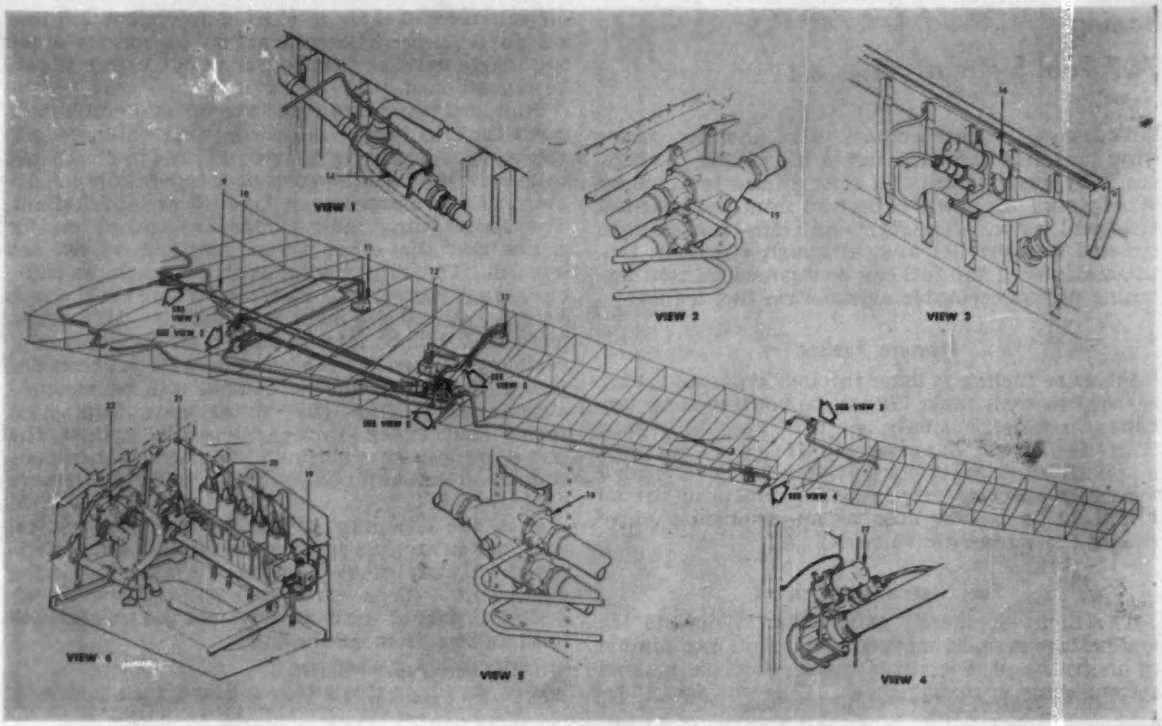


Fig. 3 — Typical layout of engine fuel feed system on Boeing 707. Metal tubing is used throughout and there are only four flexible hoses. Latter are used at disconnect point between strut and engine.

these valves, while loss of pressure (such as occurs when running out of fuel) will close them. By selecting manifold positions and operating the center wing tank pumps, fuel can be directed to any combination of engines. Check valves in the main and reserve tanks prevent reverse flow. Thermal relief is an integral part of each valve to prevent buildup of excessive pressure in the system.

Fuel Tank Vent System

The seven tanks have individual vent systems terminating at the wing tip (Fig. 4). Sealed upper wing panel stiffeners form the ducting and two ports open into each tank. One port is protected from spillage by a float-operated check valve and the other is an unrestricted open pipe. Special chambers serve to retain escaping fuel during extreme transient maneuvers and return it to the tanks when normal conditions are resumed. The vent outlet is an NACA developed anti-icing scoop which provides ram air to maintain positive pressure during all flight conditions. The vent system is sized to accommodate fuel being pumped overboard in the event of a pressure fueling valve malfunction without overstressing the tank.

Fuel Jettisoning Provisions

Fuel is jettisoned through two chutes. One chute is for the left-hand tanks and center wing tank, the other for the right-hand tanks and center wing tank. They are released electrically and actuated aerodynamically to the extended position. Each

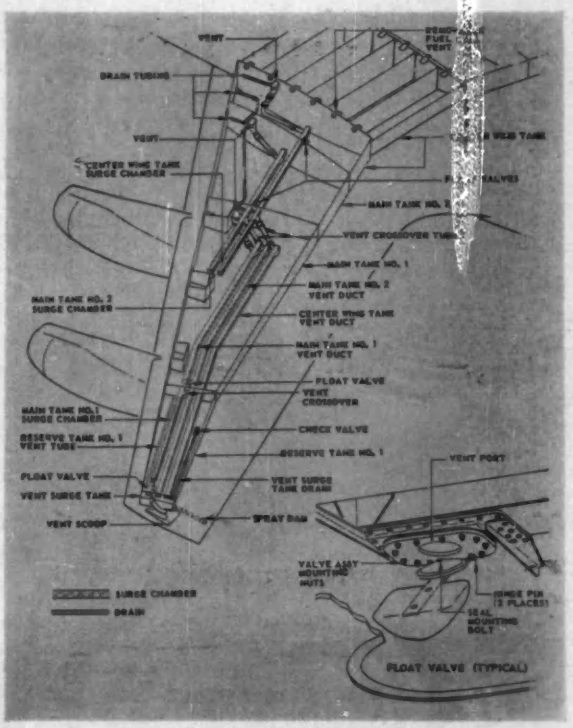


Fig. 4 — All seven fuel tanks of Boeing 707 are provided with individual vent systems terminating at wing tip.

Boeing

707 Fuel System . . . continued

tank has a separate control valve and the center wing tank has two such valves in parallel. Dumping is by gravity flow and reserves are retained by standpipes. All power is derived from the essential electrical system. The right- and left-hand jettison systems are parallel and, although one may fail, the majority of the fuel can be dumped without imposing an unacceptable asymmetric fuel loading.

Pressure Fueling

Pressure fueling is done through separate tubing systems to each tank. It can be controlled by two valves in series, but only one need operate to shut down the flow. A pressure operated valve automatically terminates flow at the full level and a manually operated valve permits control of partial filling, or it can be used as an emergency valve should the automatic valve fail.

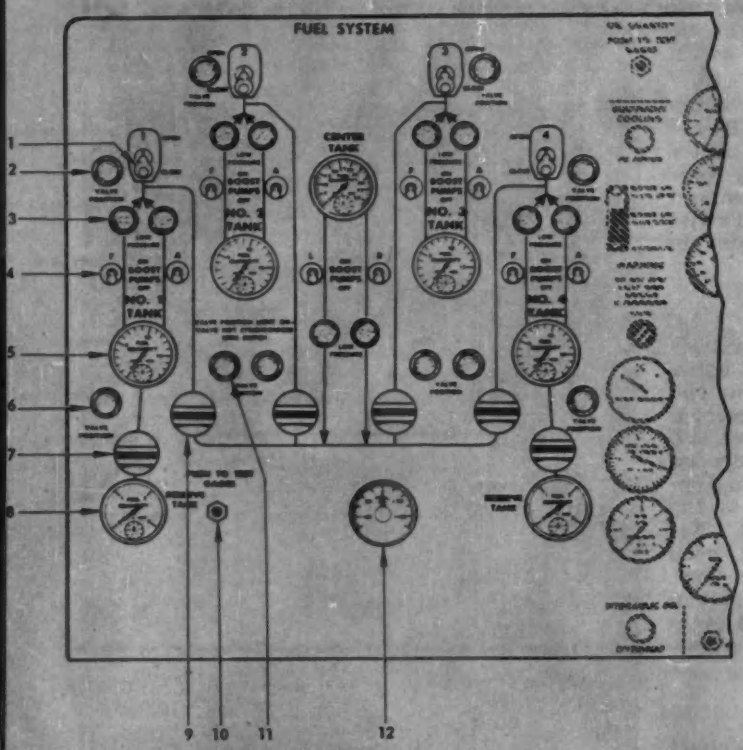
Fuel System Management

The flight engineer's panel (Fig. 5) depicts the system layout and function. There are a minimum of controls and it is virtually impossible to make a serious error in management. Only the fuel shutoff switch could cause the loss of an engine and this switch requires deliberate action to operate since the toggle handle must be pulled out before it can be repositioned.

Standard procedure is to take off and climb on a main tank to engine selection. One outboard engine manifold valve is opened to prime the manifold to permit immediate cross-feed operation in the event of an emergency on take-off or initial climb. The center wing tank pumps are turned on for cruise and the other three manifold valves are opened. The center wing tank pumps have sufficient fuel pressure to close the main tank check valves and stall the main tank pumps. All but two main tank pumps may be turned off for reasons of economy. When the center wing tank has been depleted, flow from the main tanks will be resumed automatically since the center wing tank high spring-load check valves will close against the pump's air pressure output. The flight is then continued on main tanks while transferring reserve tank fuel.

With the exception of the engine's fuel control unit, the entire fuel system will tolerate any anticipated quantity of ice without the aid of de-icing equipment. Bleed air-fuel heat exchangers installed as part of the engine protect the ice sensitive mechanisms from malfunction.

To Order Paper No. 89B . . .
. . . on which this article is based, turn to page 6.



1 ENGINE FUEL SHUTOFF VALVE SWITCH
2 ENGINE FUEL SHUTOFF VALVE POSITION LIGHT
3 FUEL LOW PRESSURE WARNING LIGHT
4 FUEL BOOST PUMP SWITCH
5 FUEL QUANTITY INDICATOR
6 RESERVE TANK TRANSFER VALVE POSITION LIGHT
7 RESERVE TANK TRANSFER VALVE SWITCH
8 RESERVE TANK FUEL QUANTITY INDICATOR
9 FUEL MANIFOLD VALVE SWITCH
10 FUEL QUANTITY INDICATORS PRESS-TO-TEST SWITCH
11 FUEL MANIFOLD VALVE POSITION LIGHT
12 FUEL TEMPERATURE INDICATOR

Fig. 5 — Flight engineer's panel shows how controls have been minimized by achieving simplicity in fuel system design. Human error in management is virtually impossible.

Profitable Survival Requires Management Planning

Based on secretary's report by

Forrest Gunderson

Westinghouse Air Brake Co.

INTEGRATED PLANNING is a new management "tool" designed to make company operations more profitable. Its success, however, depends on the caliber of management. Thus, companies should make every effort to train managers in the important areas of decision making and execution, delegation, and control of new product planning.

Technical advances have surpassed managerial advancements. Thus, there is an urgent need to provide present-day management with additional "tools." One such tool which is gaining in acceptance is "integrated planning." Since planning is simply a process of determining where we want to go, how we want to get there, when we want to arrive, and how much we are willing to pay, integrated plans clarify objectives, facilitate sound decisions, and provide a coordinated program for more profitable operations.

By using integrated planning all levels of management will be able to reach agreement regarding:

1. The precise nature of the business — what is being done and what should be done.

2. Current capabilities — strengths and weaknesses.

3. Environment — economic climate, competition, internal and external relationships.

4. Objectives — short and long range targets and goals.

5. Resources essential to achieve objectives — men, money, plant, materials, facilities, equipment, and time.

6. Authorization to proceed.

7. Criteria of accomplishment — standards of measurement.

The plan for integrated planning should:

1. Achieve its purpose with maximum flexibility, economy, and simplicity.

2. Place the responsibility for planning as closely as possible to the point of execution.

3. Enable the average person without extensive training to do acceptable planning in spite of current work pressures.

4. Provide built-in measurements and self-operated controls.

5. Outline projects within a framework of operational and corporate objectives.

If management uses this tool effectively, it will be in a better position to judge whether its projects for accomplishment such as profitability, market position, productivity, innovation, manpower development, employee attitude, and public responsibility are being maintained or improved.

The Need for Trained Management

While integrated planning is required in today's businesses, there is also the need for trained management.

Management must be trained to understand its four major functions: — planning in advance what we wish to do, organizing to achieve our goal, directing, and then controlling. This training or management development can be achieved by three means. First of all, and most important, the personal efforts of an individual's superior to determine areas of need, the formulation of a plan to develop experience in these areas, and provision for the necessary guidance and counsel. Second, the organizational structure should provide for maximum growth opportunity for the individual and insure clearcut delegation of authority and responsibility to the degree compatible with the incumbent's present and potential skill. Third, and least important, encourage formal outside training programs as a supple-

Profitable Survival

Requires

Management Planning . . . continued

mental (not substitute) to the training from within an organization.

Decision Making and Execution

Management training should include decision making and execution. Decision making is a difficult task for many, and yet it shouldn't be. You are only expected to be right two-thirds of the time. Small decisions are often harder to resolve than big ones. Knowledge of the cumulative effect of small acts tends to make some people gun shy. Furthermore, decisions made today will necessarily color or alter what action is to be taken in the future. Very often a series of decisions this year develops an atmosphere (policy, procedure, and practice) which is the format of action during extended future periods.

As an activity develops homogeneity — as policy, procedure, and practice become better known and understood — all members of the team come closer to the ideal status — the condition of realizing what will occur and what decisions should be made, prior to any act. Thus, when a decision is made, there is no surprise. Everyone is in agreement.

The execution of a decision is easiest when agreement is universal. This can exist only when:

1. Management is mature, well developed, and understanding.

2. All view the same target and create a uniform goal.

3. Adequate data and control statistics are available:

   a. Flexible budgets are used as cost policy.

   b. Standard data are used to evaluate performance of men and machines.

   c. Forecasts are a normal part of plans and are known to be reliable (they have been proven through use).

4. Most decisions are of a nature which makes them mutually satisfactory.

5. A spirit of extended cooperation exists.

6. Communication is highly developed to expedite action.

The results of every decision depend on action taken in the future. If in the future, the requirements necessary to the premises set up by the decision are not met, the end result will be altered. Planning and execution must be of a format parallel to the premises behind the decision; otherwise contemplated results will prove unattainable.

When a decision is reached, the act of getting results has just begun. As you well know, much will be delegated. Others will need to learn what is wanted and create their portion of the result desired. This requires good communication and a desire for success. After reaching a decision, a continuing effort is required to obtain all end results. These are obtained through group effort when augmented by:

1. Full knowledge of the decision and the accompanying plan.

2. An astute application of policy and procedure.

3. A steady, unabating effort.

4. Careful coordination of personal efforts.

In short, decision making and execution of the plan or program evolved is in substance the backbone of a sound management and as such requires use of every managerial resource.

Delegation

Another part of this management training should cover delegation — not abdication. While delegation is a part of decision making, next to decision making itself, it is perhaps the most complex and the least understood of all managerial techniques. Delegation is the technique wherein the executive responsible for a given function transfers part of his authority to make decisions to someone else. Authority may be divided in many ways but responsibility can only be partially delegated. An executive can delegate the responsibility for doing a job, but it is still his responsibility to see that the job is done in a satisfactory manner. It is this complication more than any other factor that makes delegation so difficult.

The arguments in favor of delegating decisions are persuasively logical. The top-level executive while retaining overall responsibility for the operation of the company and all of the related functions necessary for its operations, must delegate more and more of the responsibility for carrying out these functions as the organization grows and many of the decision-making powers that go with them.

Decentralizing authority to self-contained units helps companies to lose their appearance of vast, impersonal, bureaucratic type organizations. Decentralization, regardless of the arguments for or against, relieves top management of supervisory duties so they can spend more time planning, directing, and exercising better overall control. Delegation does not, however, relieve top management of the responsibility of controlling and guiding all major decisions and a great many seemingly minor decisions that could have a serious effect upon the company's operations.

To delegate effectively, an executive must first pick capable men in whom he has confidence in the ability to carry out the responsibilities delegated. He must be able to get them to differentiate between the major and the minor items for decisions and get them to assume the authority and responsibility for decisions on the minor items. In delegating re-

sponsibility it must be made clear the limits of authority and all the company policies that relate to the activity. A favorable atmosphere must be created in which the individual with the assigned responsibility will feel free to act within the limitations of his authority and to discuss any problems with which he is having difficulty.

The executive should study his subordinates to observe their advancement in managerial ability and growth in maturity of judgment and encourage them to make their own decisions. On the other hand, the executive must assume the responsibility for all mistakes of his subordinates and for errors committed. While both responsibility and authority can be delegated, accountability cannot.

Responsibilities should never be delegated without some kind of controls. The control techniques available determine to a large extent the type, nature, and degree of responsibility that can be delegated. Controls by top management can either be direct or indirect. Direct controls include those set up by written company policy and procedure manuals and the use of staff specialties and assistants. Indirect controls include the use of conferences and committees to discuss problems, make recommendations, and reach decisions for top managements' approval. It includes informed conversations and discussions with top management and other forms of expressions that reveal an unstated preference. Controls are necessary for delegation but the controls must be effective to determine whether the responsibilities delegated are being properly carried out.

The executive must know his subordinates extremely well and yet, at the same time, maintain a certain reserve that inspires respect. The danger of too much compatibility is that the subordinates may tend to become "yes men" and this is so particularly if the executive is a person of strong convictions and inclined to give quick decisions. In such a case, the risk of delegation is practically eliminated but the risk of bad decisions as a result of a poorly informed executive is greatly increased. In large corporations these two risks are usually present. The art of delegation lies in the ability to keep them in balance.

Control of New Product Planning

Still another portion of this management training should cover the need for management control of new product planning and the importance of coordination by various organizational groups involved in new product planning.

This control of new product planning should include a formulated policy. For example, an established objective which the company must attain could be for any of the following reasons:

1. To fill out the product line.
2. To diversify the product line.
3. To use idle plant capacity.
4. To up-date existing products.
5. To maintain existing sales and technical personnel.
6. To get ahead of competition.
7. To reduce costs and increase profits overall.

SERVING on the panel which developed the information in this article were:

panel chairman

E. J. Green, Westinghouse Air Brake Co.

panel secretary

Forrest Gunderson, Westinghouse Air Brake Co.

panel members

A. J. Lindemann, University of Wisconsin

Roger Hubbell, Allis Chalmers Manufacturing Co.

A. L. Bryant, Ordnance Weapons Command

Norman Kobart, Marquette University

Once the company's objective or objectives are established, the coordinating of the new product effort by all must be involved.

As marketing controls, it must be predicted how a new product will be accepted, in what quality, quantity, where, when — and then forecasted. In addition, an analyzation and prediction of competition both present and potential must be made.

As accounting controls, it should include break-even charts under varying conditions, pricing policy, and progress reporting. Of particular concern, the pricing policy to be used must be selected and coordinated with the other activities. This pricing policy could be any of the following:

1. As much profit, as soon as possible.
2. Discourage competition.
3. Recover research and development costs in a given time.
4. Yield the "regular" rate of return.
5. Win speediest market acceptance.
6. New product as "leader" for a line.

As production controls, the new product forecast must be tied into a master schedule with the proper lead times. Also, a capability analysis both quantity and quality-wise must be made.

Finally, as sales controls, it is necessary that the advertising be fully coordinated and that any information on consumer acceptance and competition be properly fed back.

(This article is based on a secretary's report of a production panel entitled "Management Planning for Profitable Survival." This report — along with 8 other secretaries' reports on various tractor production subjects — is available in multilith form as SP-324. See order blank on p. 6.)

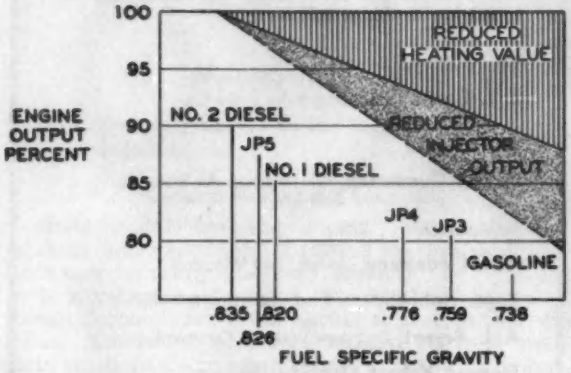


Fig. 1 — Effect of fuel gravity on engine output of GM Model 71 diesel engine.

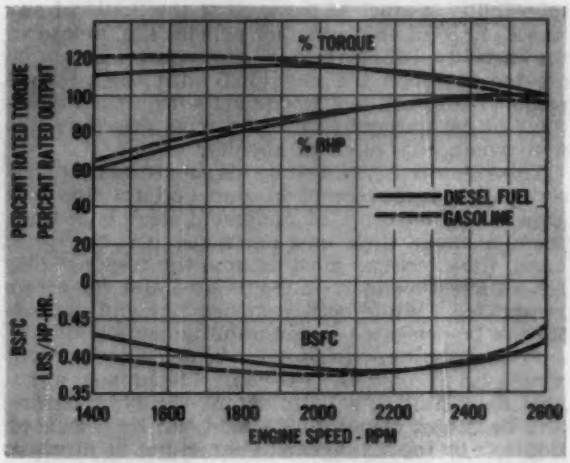


Fig. 2 — Relative performance with gasoline and diesel fuel of Continental Hypercycle engine.

Multifuel Engines

have proved themselves for future production, say research engineers

MULTIFUEL piston engines have already proved themselves practical for future production. Both foreign and domestic developments meet the basic requirements for fuel tolerance. Techniques for temperature control have been devised which give broad coverage.

Only trouble is that all the multifuel engines so far developed are too large and too heavy to suit the taste and needs of the military . . . which sees the spectre of global war calling for air delivery — and making every inch and pound critical.

But civilian and military engineers are agreed on the relative success of the many-pronged search for a piston-engine design which will accommodate gasoline, middle distillate, and heavy fuels.

GMC's experience at its Detroit Diesel division, for example, indicates that GM's 71 diesel — with minor modifications to the fuel system — can be operated satisfactorily on 80-octane gasoline and aviation turbine fuels, as well as on normal diesel fuels. The effect of fuel gravity on the output of this powerplant is shown in Fig. 1.

Continental Aviation and Engineering's long multifuel experience indicates that the latest Continental Hypercycle model has reached a stage of development which is thoroughly comparable with the ordinary diesel engine. Fig. 2, resulting from tests on Continental's Model LDS-427 Hypercycle engine, shows the engine's comparative performance on gasoline and on diesel fuel. This engine weighs approximately 8.5 lb per hp. It is built primarily of cast iron, little development work yet having been done to reduce its weight.

Though the current engine is useful only to the military at present, Continental spokesmen feel that:

"The present gap between the high-compression spark-ignition system on the one side and the true multifuel compression-ignition engine on the other may be narrowed and eventually closed, so that one internal-combustion system using all kinds of fuels will result. Stratified mixture, new ways to initiate ignition, and combustion control through vaporization rate may be ways toward this ultimate goal, which undoubtedly is worth the effort . . . and is nearer to reality than is commonly thought."

International Harvester studies also have shown that compression-ignition engines are able satisfactorily to consume a wide range of fuels . . . including gasolines meeting the MIL-G-3056A specifi-

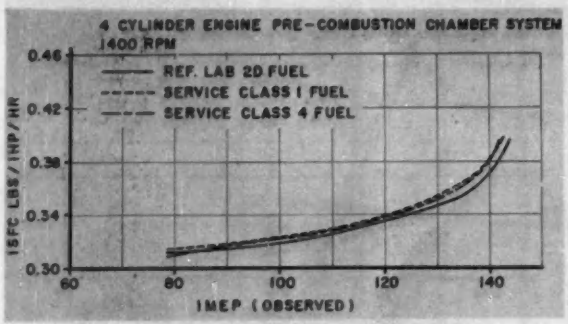


Fig. 3 — Variable-loaded fuel consumption characteristics of service class 1 and 4 fuels on International Harvester precombustion-chamber compression-ignition engine.

cations of 91/84 octane ratings. Tests in subzero weather, using four reference fuels of the service classes defined by the Bureau of Mines, have shown that all these fuels could be used satisfactorily in the IHC precombustion-chamber engines. Variable load fuel consumption characteristics of the service class 1 and 4 fuels (shown in Fig. 3), for example, compared favorably to the reference 2-D diesel fuel with respect to fuel economy and thermal efficiencies.

Studies in this multifuel-engine area lead Mack engineers to conclude:

"To apply the multifuel idea to existing diesels is a task that will have many stumbling blocks to overcome." With gasoline, Mack engineers point out as an example, that some protection must be provided to prevent rusting by air in the system. . . . Plunger and barrels and delivery valves may have to be made of corrosion-resistant material. . . . Nozzle tips may have to be made of nitralloy, not only to guard against corrosion, but also to make them heat resistant. . . . Springs in the nozzle holder and the delivery valve — in fact, any spring operating in the fuel — should be of corrosion-resistant material. . . . The elimination of fuel bubbles in the fuel system is important. It may even be necessary to separate the feed gallery and institute a spill-over gallery.

Military researchers agree that a multifuel engine needs a controlled combustion system, which they say, means "a soft combustion with a rate of pressure rise between 30 and 100 psi per deg crank angle . . . and also light weight as soon as the hard diesel knock is banished."

"Tests have shown," according to Adolph Lurken of the Army Engineer Research & Development Laboratories, "that the real multifuel systems carry loads of 170 psi when supercharged . . . and even more with intercooling.

"In the future," he concludes, "these improved combustion systems will outperform the old conventional methods."

Fig. 4 is a Lurken suggestion of "how to modify an existing diesel to a multifuel engine."

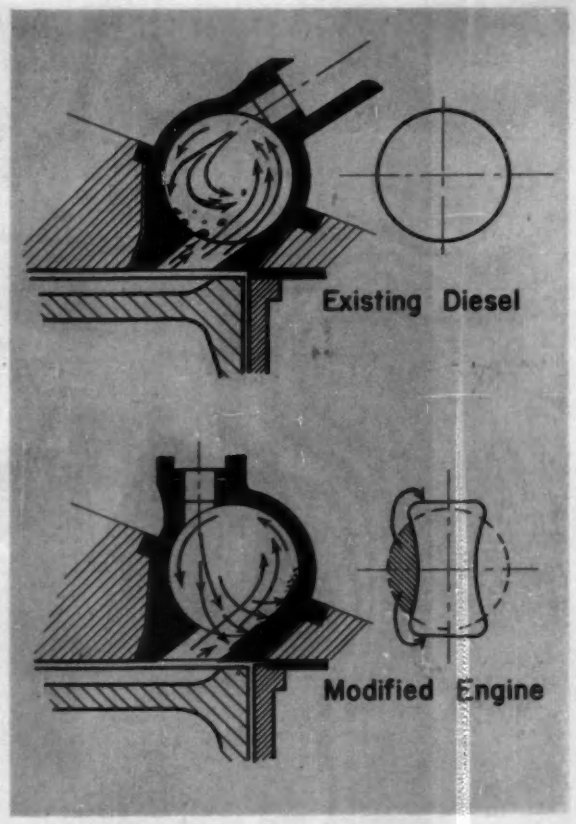


Fig. 4 — Suggestion of one way to modify an existing diesel to a multifuel engine.

This article is based on data presented at a "Multifuel Engine Symposium."

Participating were:

E. F. Blackburne and R. H. Sawyer
Ordnance Tank Automotive Command

E. J. Godlew and H. S. Ford, Jr.
Detroit Diesel Engine Division, GMC

H. H. Haas
Continental Aviation & Engineering Corp.

William Lenzi
International Harvester Co.

Bruno Loeffler
Mack Trucks, Inc.

Adolph Lurken
U. S. Army Engineer Research & Development Laboratories

To Order SP-158 . . .
. . . on which this article is based, see p. 6.

Charles F. Kettering

1876-1958

CHARLES FRANKLIN KETTERING, president of SAE in 1918, died at his home in Dayton on November 25.

Famed and honored throughout the world for his tremendous contributions to engineering and science, he was always "Ket" to SAE men, as he was always "Boss Ket" to his General Motors associates. Throughout every year of the last quarter of a century, new awards, medals, and honors were heaped on "Ket," the first of whose many outstanding mechanical and scientific contributions to mankind was making the automobile self-starter practical. But to the end of his life, the Society of Automotive Engineers held a very special place in "Ket's" interest.

His renowned wit and penetrating comments on people and problems have been in evidence in the intimate exchanges of the annual informal dinner of the SAE Past-Presidents Advisory Committee almost every year since its inception more than a decade ago. "Ket" topped the program for SAE at its 50th Anniversary Meeting in 1955. He was the main speaker at the SAE dinner in Chicago, which was SAE's participation in the Centennial of Engineering celebration in 1952. He has been a visitor at almost every SAE Annual Meeting Engineering Display since that event started in 1934.

"Ket" has imbued at least three generations of SAE members with his stimulating conviction that the world will never be finished; that the greatest challenges continue to lie ahead.

Many times he chose the Society of Automotive Engineers as a platform from which to announce the engineering significance and technical detail of his never-ending series of engineering developments. Typical was his paper, "More Efficient Utilization of Fuels," which first told the story of his high-compression engine development, presented at an SAE Summer Meeting at French Lick, Ind., in 1947.

Ket's encouraging philosophy for fellow engineers might be illustrated, if not summed up, in his statement that 99.9% failure is essential to successful research. Being successful only 0.1% of the time, he pointed out, can mean startling contributions to scientific progress.

Lockheed Lightning Loading

speeds handling of cargo to capitalize on

Based on paper by
E. W. Fuller and R. F. Stoessel
Lockheed Aircraft Corp.

Time and motion studies indicate that it takes four elapsed aircraft hours on the ground, and 38 man-hours to load and unload manually 18.7 tons of air freight, with a payload penalty of 2% for dunnage, in the C-130 Hercules.

Utilizing mechanized, pre-unitized, loading methods, this same operation can be performed in 20 min and 30 man-hours at rates of 112 tons per loading hour and 1.2 tons per man-hour, allowing a 7% penalty for dunnage. This reduction in loading time, added to an average 8-hr manually loaded aircraft daily utilization, increases air lift capacity 40% even with the 5% payload penalty imposed by added dunnage. It eliminates one out of every five persons required to load.

Below is a comparison of hand and mechanical loading systems, and on the following pages is a series of pictures showing how the mechanized system works.

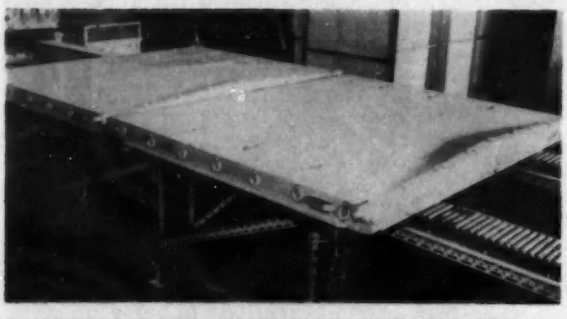
Comparison Summary of Air Freighters and Loading Systems

Airplane	Payload lb	Cruise Speed, mph	Time per Stop		Daily Utilization	
			500-Mile Distance	1500-Mile Distance	500-Mile Distance	1500-Mile Distance
			Hr:Min.	Hr:Min.	Hr:Min.	Hr:Min.
			With Hand Loading			
A	15,000	195	0:40	1:00	10:40	9:55
B	20,000	225	0:55	1:20	9:55	9:40
C	30,000	290	1:25	2:00	8:05	8:50
D	45,000	325	2:05	3:00	6:40	7:35
E	70,000	380	3:15	4:25	5:00	5:55
			With Mechanical Loading			
D			0:35	0:50	10:50	10:30
	Improvement				62%	38%
E			0:35	0:50	10:35	10:30
	Improvement				112%	78%

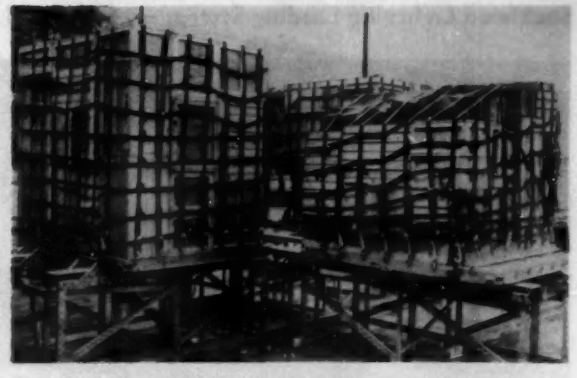
System . . .

potential of modern airfreighters

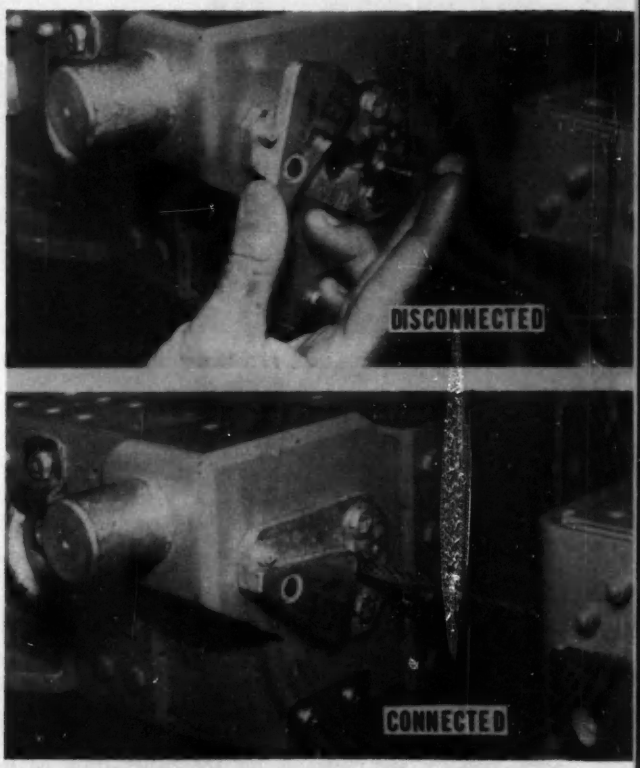
1. PREPARATION OF UNIT LOAD ON PALLET. Outgoing freight is brought to the terminal for unitizing, or it may be received already unitized on pallets furnished by the shipper. It is then secured to the pallet by harness. All or part of any shipment may be in containers as long as the container unit size is within pallet cube and weight limits. Incoming shipments can be de-unitized in the terminal or delivered to the shipper for dispersal. In either case, unrestricted access to all sides of the load during unitization and de-unitization process permits efficient handling, minimizes stacking loss, and accounts for a 21% reduction in labor.



2. LIGHT-WEIGHT, HIGH-STRENGTH PALLETS are dimensioned to fit economically into both the cargo aircraft and a standard truck body. During unitization they are positioned on standard roller conveyor sections for ease of movement. Upon completion of unitization they must be positioned in tandem for transfer to the aircraft.



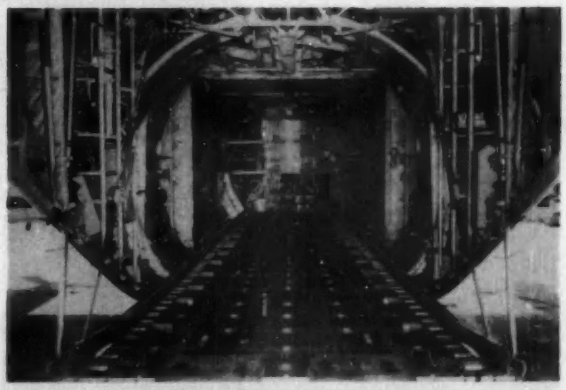
3. LATERAL TRANSFER POINTS are provided in the terminal to shift pallet units from the unitized area onto a conveyor line to await transfer to the aircraft. They are assembled from standard conveyor and hydraulic accessory stocks. They also provide the means for shifting through pallet units from incoming to outgoing loads at intermediate stops. In any terminal, the number of lateral transfer points depends upon the number of pallets in the largest load to be accommodated and the number of such loads to be handled simultaneously. Here are shown two pallet units at a transfer point ready to be assembled into an aircraft load totaling five units.



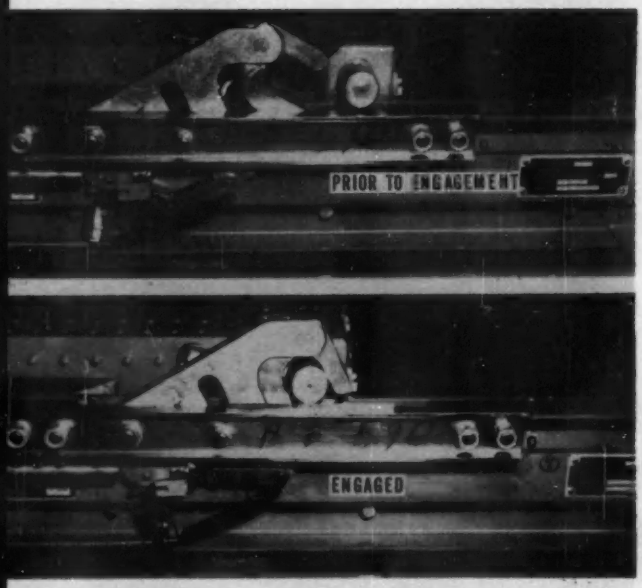
4. QUICK-DISCONNECT CABLES couple the units together to form a pallet train for simultaneous movement. When a full complement of pallets has been assembled in the terminal, a low-boy trailer backs into position to receive the train and loading for transfer begins.

continued

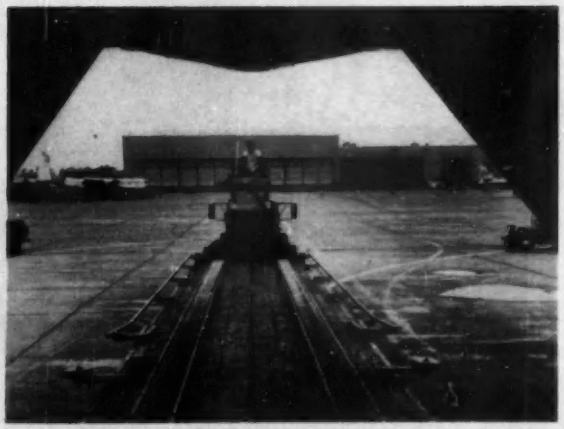
5. TRANSFER OF PALLET TRAIN TO TRAILER is accomplished by two electric winches controlled by an operator from a vantage point on the trailer gooseneck. Using a continuous cable, one winch is used to pull the train over standard conveyor sections on the trailer, while the other acts as a safety brake. When the load has been secured to the trailer bed with safety stops, it is ready to be moved to the aircraft which may be parked randomly for loading where there is space for maneuvering.



6. INSERTION OF LOAD INTO AIRCRAFT is done by positioning the trailer at the aircraft ramp. The gap between trailer and ramp is bridged by removable dural plates, shown in the foreground. The winch system is used to pull the pallet train into the cargo compartment where the pallet is latched automatically into position ready for flight.



7. AUTOMATIC LATCHES are positioned along the top of each rail. Pins on the pallet sides engage these latches to secure all pallets to the airplane structure. On the floor at the sides of the cargo compartment are quickly removable serial delivery system rails and rollers to provide guidance, mobility, and restraint for the pallet train as it enters the compartment.



8. SPEED OF PALLET UNLOADING matches that of loading. The empty low-boy trailer is backed into position at the aircraft ramp and dural plates are placed to bridge the gap. Then a foot treadle is actuated which releases all latches simultaneously and frees the pallet train to be pulled onto the trailer with the winches.

To Order Paper No. 86C . . .
. . . on which this article is based, turn to page 6.

How ANP Turbine Lubricants Behave Under High-Level Radiation

Based on paper by

John M. Clark, Jr. and George C. Lawrason

Southwest Research Institute

RADIATION can produce almost instantaneous failure of modern aircraft lubricants, tests at Southwest Research Institute show. Two types of failures demonstrated are rapid viscosity rise and loss of heat conductivity. Furthermore, it was found that lubricants can become excessively corrosive under high-level radiation.

In the conduct of these studies, many oils were screened in an irradiated, modified WADC deposition tester and in an irradiated corrosion-deposition tester, and finally tests were made with an irradiated version of the WADC high-temperature bearing head.

Modification of the WADC deposition test allowed the use of radiation so that baseline or unirradiated data would be comparable to background data on the standard test. Its use was expected to reveal a sharp increase in sludge and coke weights with a resultant high deposition number. Actually, the deposition number dropped in many cases and showed but a slight gain in others. Generally speaking, the better lubricants appeared to improve in performance while marginal ones deteriorated to a greater extent under the radiation. When the better lubricants were subjected to considerable static irradiation prior to the deposition test, there was a minor increase in deposition number as the total dose was increased.

Evidence of Increased Corrosion

Pre-irradiation revealed an attack on the pure aluminum coking tube. Heavy pits and corroded areas appeared in addition to overall etching of the tube evidenced by a weight loss. From this it was concluded that corrosivity of the fluid might be altered substantially due to the radiation damage during the dynamic test.

When samples of copper, silver, aluminum, mag-

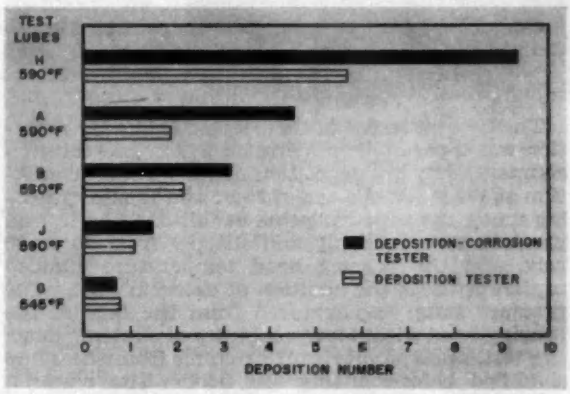


Fig. 1 — Corrosion-deposition tester tended to increase the deposit forming characteristics of those lubricants that had increased deposit forming characteristics in the irradiated deposition test.

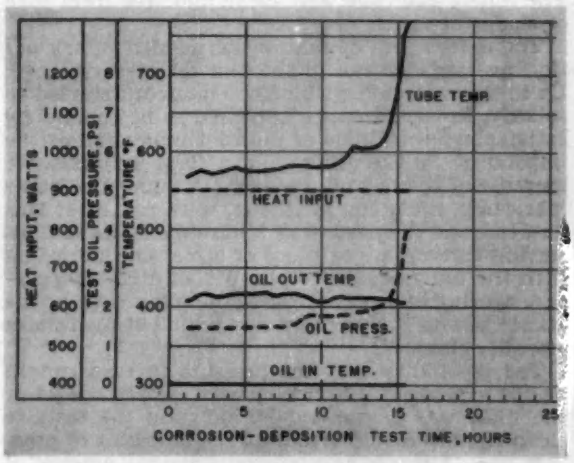

HEAT INPUT, WATTS
1200 1100 1000 900 800 700 600 500 400
TEST OIL PRESSURE, PSI
8 7 6 5 4 3 2 1 0
TEMPERATURE °F
700 600 500 400 300
TUBE TEMP.
HEAT INPUT
OIL OUT TEMP.
OIL PRESS.
OIL IN TEMP.
0 5 10 15 20 25
CORROSION-DEPOSITION TEST TIME, HOURS

Fig. 2 — Performance of a relatively unstable lubricant in the constant energy input corrosion-deposition tester. Failure follows quickly upon a change of lubricant properties.

How ANP Turbine Lubricants Behave Under High-Level Radiation

. . . continued

nesium, iron, and lead were tested in a corrosion-deposition tester, severe weight losses were observed during 12-hr runs; 300 to 400 mg/in.^{2} being common for lead, copper, or silver. With one lubricant there was a plating of the copper onto the surface of the aluminum specimen. The plating was so thick as to require an acid strip to remove the copper to obtain the true weight of the aluminum specimen. The corrosion-deposition tester tended to increase the deposit forming characteristics of those lubricants which had increased deposit forming characteristics in the irradiated deposition test (Fig. 1). At this point we avoid using the word stability because we now know the deposition number is an unreliable index of stability of a lubricant operating under radiation.

Sharp Rise in Viscosity

The first oil tested in the bearing rig under radiation was a paraffinic mineral oil which had shown a comparatively low deposition number under irradiation at 590 F. At the end of 25 hr and 15 min of testing under dynamic radiation conditions, the test oil pressure rose suddenly and sharply from 20 to 60 psig, and the bearing head temperature climbed rapidly without the addition of external heat. The pressure sump was removed from the face of the bearing head within a few minutes of shutting down the test, and the lubricant dripping from the sump solidified before hitting the floor. The material within the reservoir was a tough, tarry substance which resisted the efforts of hot degunking baths and had to be removed by chipping and scraping and given a final cleanup with emery and crocus cloth. The rollers and cage were clean and free from coke or sludge deposits.

The mechanism of failure was sudden; quick action averted damage to the test oil pressure gage. Up to the moment at which the lubricant started to solidify, its performance appeared to be completely satisfactory with little or no prior indication of the impending failure other than a slow, unimpressive increase of the test oil pressure. A number of other lubricants, including synthetic, were run after this first test and the pattern of failure was quite similar. During three years or more of screening lubricants with the unirradiated 100-hr WADC high-temperature bearing test at Southwest, there has been no instance in which a lubricant has exhibited such sharp viscosity changes.

The possibility that the pressure increase might be due to sludge formation or hard coke in the jet or the filter was eliminated by stopping the tests to clean the filters and orifice at the first hint of pressure rise. There is normally only a small amount of sludge formed during the dynamic radiation bearing test. In fact, there appears to be a definite reduction of sludge and coke formation when this test is operated irradiated as compared to unirradiated. It is not a general rule for all lubricants, but only for those that show a high degree of thermal stability.

Loss of Heat Transfer

During some of the corrosion-deposition tester runs, a considerable reduction in energy output to the coking tube was required toward the end of the test to maintain a constant coking tube temperature. For this reason another look was taken at the method of stressing the lubricant and it was concluded that a constant heat energy input test would offer more realistic data than the conventional constant-temperature type of test.

Fig. 2 illustrates the performance of a relatively unstable lubricant in the constant energy input corrosion-deposition tester. Once the properties of the lubricant began to change, the failure generally occurred within a short period of time. As the heat acceptance capability of the lubricant decreases, the temperature of the coking tube starts to increase and accelerates the degradation of the lubricant. In contrast, the constant-temperature type of test reduced the energy input to maintain a constant tube temperature and prolonged the test by favoring the immediate capability of the lubricant to remove energy from the coking tube.

As to fatigue life, one test was run for a total of 300 hr and there did not appear to be any damage to the bearing. On the other hand, one of the qualified MIL-L-7808 lubricants which has shown consistently high stability under radiation demonstrated a surprising fatigue or corrosion phenomenon. After approximately 72 hr of running, the temperature of the bearing began to climb at a precipitous rate and, upon examination the 100-mm roller bearing, was found to have about 1/16 of an inch total clearance. The surface of each roller had spalled or flaked off to a depth of 0.015 in. The races appeared to be unchanged, the rollers alone being damaged. The only indication of this failure had been the sudden rise in bearing temperature, so the pattern of failure is difficult to define. It is unnerving to view this phenomenon and realize it may happen with other lubricants at some unpredicted dose level.

Use of Cobalt-60

To obtain the high-level radiation for these tests, high specific activity cobalt-60 emitting gamma radiation was selected as being most practical. Neutron irradiation probably would be more damaging, therefore, any material unable to resist gamma radiation would undoubtedly perform poorly under neutron irradiation. Gamma radiation leaves the test equipment and fluids "clean" with no induced radioactivity to make detailed inspection difficult. The maximum available flux from a cobalt-60 source is a function of the specific activity of the source and within reasonable limits is relatively independent of the total number of curies. Hence, it is possible to attain fields of ten times the flux level with one-tenth the total number of curies by using material having a specific activity 30–40 times the usual low specific activity source.

To Order Paper No. 92D . . .
. . . on which this article is based, turn to page 6.

Aberdeen Highlight of Transportation and Diesel Engine Meetings

FOREIGN VISITOR K. H. Schmidt (left) chats with C. F. Schwarz (center) and SAE President William K. Creson (right). Schmidt, from Faun-Werke, Nurnberg is the owner of the only privately owned truck manufacturing company in West Germany. Schwarz was chairman of the spectacular ordnance show held at Aberdeen.

LIGHTER, FASTER, and stronger is the keynote of the vehicles demonstrated to 500 SAE members and guests attending the Ordnance Show at Aberdeen Proving Ground. A full day of the SAE National Transportation and Diesel Engine Meetings, October 20–24 at Baltimore, was set aside for the ordnance demonstration.

New and old vehicles ran side by side in a mobile display in the afternoon, and when they stopped, the engineers were inside, underneath, on top of, and all around them. Each SAEer had a different point to check and perhaps wonder how the best of equipment could stand up under the grueling runs on the test tracks.

Some of the test tracks stretched the imagination — and the vehicles. Four foot high rolling humps, alternately spaced on the right and left, lifted truck wheels and twisted the frame. Foot high bumps spaced every couple of feet made for a tooth jarring ride at high speed. Sixty per cent slopes punished engines, transmissions, and brakes. (Some members found that you can't walk up a 60% slope without sneakers.) These and other tests were watched with interest (see pp. 82–83).

SAE's Truck and Bus Activity, Transportation and Maintenance Activity, and Diesel Engine Activity, with the help of the SAE Baltimore Section, presented a program of 9 technical sessions. Topics discussed were: New Developments in Truck Service Brakes, Utility Engine Combustion Chamber Deposits, Diesel Engines for Light-Duty Operation, Concepts in Truck Cooling Systems, Multifuel Engines, Fiber Glass in Truck Bodies and Cabs, Cold Starting Diesels — Supercharging the Free-Piston Engine, Turbocharged Diesel Engines, and Intercooling of Diesel Engines.

Better than 200 engineers attended the luncheon at which Major-General Frank S. Besson, Jr., Chief of Transportation, U.S. Army, spoke on Ground Mobility in the Atomic Era. William M. Holaday, Director of Guided Missiles, Department of Defense, was toastmaster at the luncheon.

Over 400 attended a Maryland-style oyster roast sponsored by SAE Baltimore Section. Plenty of good food, barber shop harmonizing, and just plain old socializing were the order of the day.

Programs for the 9 technical sessions were planned by a committee headed by General Chairman Fred A. Robbins, chief engineer, Koppers Co., Inc.

GUEST SPEAKER at the luncheon was Major-General Frank S. Besson, Jr. Besson discussed the Army's role in "Ground Mobility in the Atomic Era."

Technical session chairmen were: R. K. Super, Rockwell Spring and Axle Co.; W. L. Bennett, Baltimore Transfer Co.; William Kaplan, American Oil Co.; W. T. Burwell, General Motors Corp.; C. F. Schwarz, Ordnance Corps, Aberdeen Proving Ground; J. V. Bassett, Raybestos-Manhattan, Inc.; Laskar Wechsler, Bureau of Ships, U. S. Navy; P. S. Meyers, University of Wisconsin; and A. R. Schrader, U. S. Naval Engineering Experiment Station. G. C. Milan, chairman, SAE Baltimore Section made the welcome address to engineers at the meeting.

Also present at the meeting were: L. D. Thompson, vice-president of SAE Diesel Engine Activity; E. B. Ogden, vice-president of SAE Transportation and Maintenance Activity; and R. R. Burkhalter, vice-president of SAE Truck and Bus Activity.

Capsules of technical sessions—p. 80 . . . . . Ordnance Day at Aberdeen—p. 82

Monday

new developments in truck service brakes

An ICC spokesman suggested that brake manufacturers direct their efforts toward improved reliability and ruggedness, reduction or elimination of the tendency to fade in prolonged applications, better balancing, more accurate and faster control, distribution of better information regarding brakes to the people who use and maintain them.

Liquid-cooled and internal-expanding brakes have been developed to meet the requirements of higher truck speeds and heavier loads.

One company has developed disc brakes which, through piping connections, uses radiator coolant for heat dissipation. These brakes are similar in principle to those used on high-speed aircraft but are adapted to the requirements and limited space available in motor trucks. Housings are made of aluminum and the discs of steel, with lining bonded to both faces, and copper friction plates riveted to outer housings. An automatic adjuster maintains constant clearance between copper wear surfaces and the brake lining. Radiator coolant is circulated by a pump.

The results of road tests show that the brakes operate with minimum wear and can be applied repeatedly without heat build-up. The design has been adapted to propeller shaft brakes which can be used as retarders and parking and emergency brakes. Indications are that both the disc and propeller-shaft brakes will have a service life equal to engine-overhaul periods. (paper 96C)

Another company has developed internal-expanding shoe drum brakes satisfactory for use in limited space and with smaller wheels. The brakes can be installed without truck design changes and are only 15 in. in diameter.

The brakes can be actuated either by air or hydraulic means, with hydraulic cylinders placed outside the brake to avoid heating difficulties and brake fluid boiling.

Road tests on flat land and in mountainous country have revealed an increase in brake performance, greater resistance to fade, and prolonged wear life. (paper 96B)

utility engine combustion chamber deposits

All engines suffer from deposit power loss. But, power-loss effects are most severe in the constant-speed, constant-load service common to the auxiliary or utility type engines.

Deposits cause power loss by reducing both thermal efficiency and volumetric efficiency or breathing capacity. Roughly two-thirds of this loss results from decreased air consumption which, in turn, results from physical and thermal restriction of the intake charge.

Probably no other fuel or oil variable has received more blame for power loss than has tetraethyl lead. Since the presence of tel in the fuel increases deposit weight over that with clear fuel by several times, it is commonly believed that power loss also is increased several times. Actually, the effect of deposits on power loss is highly variable, and is almost entirely dependent on the type of service or engine operating conditions encountered. This effect is greatest under constant-speed, constant-load conditions.

Since the greatest part of deposit power loss results from decreased air consumption, proper attention to engine design can go a long way toward reducing these losses. The new multigraded oils may offer some relief from deposit problems because they form less resinous material. Carbon removal by physical or mechanical means also may be beneficial in some cases. Using the right engine for the job and adherence to a strict preventative maintenance schedule also will help reduce deposit power loss. (papers 97A and 97B)

Capsule reports of 9 technical

Wednesday

diesel-engines for light-duty operation

Pressurized bottles gas is proving to have many advantages over liquid fuels in operating light-duty motor trucks, buses and tractors. Increased safety, improved performance, easier maintenance, and, in many cases, reduced operating costs are among the advantages cited.

The use of liquefied petroleum gas eliminates the need for fuel pumps in motor vehicles, increases spark plug life by burning without deposits, extends periods between engine overhauls, increases oil life, and reduces downtime for repairs. Taxicab companies are reported as saving an average of a half-cent per mile in operating costs, and fork lift and refrigerated truck lines as reducing maintenance costs by $200 to $500 a year. (paper 98B)

Diesel engines are now available for use in light delivery vehicle and taxi service. Although a typical diesel for this type service is 100 to 150 lb heavier than a typical gasoline engine, no serious difficulties are experienced in installation. At normal and high road speeds the noise level of the diesel is about the same as that of a gasoline-powered vehicle. At idling and when accelerating from rest there is some increase in noise.

Cold starting is facilitated in one diesel by means of a heating unit situated in the intake manifold. A special

Thursday

multifuel engines

Multifuel engines now being developed for military vehicles will benefit peacetime commercial transportation.

The powerplants will be capable of operating on gasoline, jet fuel, airplane gasolines, diesel fuels, lubricants, or mixtures thereof. Neither military nor commercial vehicles can function equally well on all these fuels, or on the mixtures, but the big point is that they will operate on any fuel available anywhere.

Compression ignition and free-piston engines, as well as turbines, seem to meet requirements for powerplants which can operate on all types of fuel without manual adjustment, start without off-engine aids in temperatures of −25 F to +115 F, develop full power, and weigh no more than 6 lb/hp. Application of the M.A.N. multifuel engine theory, developed in Germany about 1953, has helped with the problem, but changes have been made in order to reduce weight and bulk and to improve the operation of diesel-type engines on gasoline.

GM's standard and turbopower 71 engines are capable of operating on a wide range of fuels. Only minor modifications of the fuel injection system are required for satisfactory operation on gasoline.

Continental has developed the Hypercycle combustion system along lines originated for the M.A.N. engine, with the result that the 6-cyl powerplant shows good fuel consumption and lugging torque, and even exceeds diesel performance at low speeds.

On the basis of test results, International Harvester's precombustion chamber engines can, with a minimum of

Papers on which these capsules are based are available in full in

device developed for the fuel pump eliminates smoking under cold starting conditions, and at high engine speeds when operating at light loads. This device is sensitive to engine load and speed and advances the injection timing as the engine load is reduced. Performance of this diesel is practically identical to that of a gasoline engine of like output. Average fuel consumption figures indicate it to be 2½ times as economical as the gasoline engine.

Initial cost of a diesel taxicab is higher, but the net saving in cost of operation over a life of 150,000 to 200,000 miles is said to be $700 to $1300. (paper 98A)

concepts in truck cooling systems

A truck cooling system has the basic job of maintaining temperatures which enable the engine and some other operating parts to function consistently and persistently at close to peak performance. The job has been complicated by additional duties, such as cooling automatic transmissions, air compressors, and oil tanks. And now the radiator is being called on to maintain proper temperatures in liquid-cooled brakes and speed retarders.

Even if the designer could develop a perfect cooling system, it would work well only at the equator, whereas trucks in actual service operate in temperatures ranging from 20 deg below zero to 120 deg above.

"The perfect cooling system must not only reduce metal and liquid temperatures at elevated ambient temperatures, but must also be capable of maintaining elevated metal and liquid temperatures at reduced ambient temperatures."

Resort now is being made to thermostats and other temperature-control devices, such as fans and radiator shutters, and it looks now as if all three, plus proper maintenance, must be used to achieve maximum results. That is, if the customers will pay for them. (paper 99A)

Aeration, the entrapped and entrained air in the water or coolant, causes a definite loss in truck cooling system output. It is due to poor design and it can cause not only loss of coolant, but over-heating, poor cooling, and expensive maintenance. (paper 99B)

A full analysis of truck cooling system performance is seldom completed and has rarely been reported. This is so because the nature of the cooling airflow and a measurement of its magnitude in the complete installation is unknown.

Individual pieces of data on component performance are difficult to use by themselves except for the purpose of moving up or down a small amount from a known situation. However, a system chart can be used on which data on individual component performance are superimposed. This will lead to a much better understanding of what is happening than when data fragments are viewed individually. (paper 99C)

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revisions, be utilized as multifuel engines in their present speed ranges up to outputs of 95 bmep.

Results presented by Mack Trucks showed that operations on gasoline were attended by knocking, whereas a mixture of gasoline and lubricating oil gave far more satisfactory performance. (SP 158)

fiber glass in truck bodies and cabs

Successful use of fiber glass in producing cab bodies for motor trucks suggests broadening automotive applications. Advantages claimed for fiber glass over metals include its light weight, nonrusting qualities, greater elasticity, sound-deadening qualities, insulating properties, and lower thermal conductivity factor.

The cost of manufacturing a cab of fiber glass is higher than making one of steel. However, the tooling cost is considerably lower. Furthermore, more intricate shapes can be made without fear of tearing or having objectionable springback because parts are molded instead of being stamped. This also means that fewer parts are necessary to make a cab. (paper 100A, 100B, & 100C)

cold starting diesels — supercharging the free-piston engine

Priming fluid, to start a diesel, must be supplied initially at a high rate to keep cranking time short. After the engine has accelerated to warmup speed, the rate should gradually decrease . . . and become zero when the regular fuel will ignite without assistance from the priming fluid. For every temperature-engine combination, a minimum initial rate exists for a start within a given number of seconds. (paper 101A)

Supercharging in the free-piston cycle is definitely attractive as a means of increasing power and reducing part-load fuel consumption. But to get the advantages, the total cycle presure must be increased. Adequate cooling of the air is necessary for control of temperatures and of power cylinder excess air in the maximum power ranges. These are among the conclusions to be drawn from a series of analytical studies, backed by actual tests, concerning the use of supercharging in the free-piston cycle. (paper 101B).

Friday

turbocharged diesel engines

Turbocharging and aftercooling are direct means of increasing the power output of diesels. Higher specific power outputs, lower thermal loads and wall temperatures, result from turbocharging. Extensive tests have shown that the oxygen content of the cylinder determines the amount of fuel burned per cycle and, therefore, the power output. (paper 102A)

Aftercooling is recommended for turbocharged diesels as an effective way to get more power from less bulk and weight of engine. Higher pressure turbocharging has much to offer, but it should be used in conjunction with aftercooling to reach its best potential. Without aftercooling, the engine pays a heavy price in terms of increased mechanical and thermal loads for a limited output increase. (paper 103A)

multilith form from SAE Headquarters. See order blank on page 6.

HOLDING BACK A TANK is the job of the mammoth field dynamometer being inspected by (right to left) President Creson, Past-President Cass; Peter Altman, member of the Technical Board; E. B. Odgen, vice-president for Transportation and Maintenance Activity and member of the Technical Board; Col. Powell, George Milan, chairman of SAE Baltimore Section; and Edward Brown, member of the Technical Board. The mobile dynamometer along with tank instrumentation gives the overall performance of the tank and its major components, such as the transmission and drive line.

A WORLD WAR I command car brought SAE President Creson, Col. Powell (left), and Col. Armitage to the opening of a dynamic demonstration. The whole Munson Automotive Test Area of Aberdeen Proving Ground was used to show SAEers how military vehicles are developed and tested.

Ordnance

THE MECHANICAL MULE drew a crowd after members saw it work as a soldier's "carry-all". You can drive it sitting on top, leading it along, or crawling behind it on the ground. The mule is light enough (950 lb) for air transport, carries an 800-lb payload plus driver, and is governed to a 25-mph top speed. There are no suspension or electrical systems, wheel brakes, differentials, or instruments. The mule is controlled by a hand-type brake on the front axle input shaft, a three-forward-speed transmission, and a moveable steering column.

MORE THAN TWO DOZEN vehicles were open for inspection after they finished test runs for SAE members. They included jeeps, trucks, ducks, gun carriers, tanks (a couple of rounds were fired that raised the fellows off their seats), rocket launchers, tankers, and tank retrievers.

THE "HONEST JOHN" ROCKET is carried and launched from this 5-ton truck. The truck is standard in design with the exception of an extra long wheelbase chassis. The rocket is loaded on the launcher by a 5-ton medium wrecker. The launcher can be elevated by power or by a hand crank. Traverse is by hand power.

A CLOSE LOOK at a heavy 6×6 truck is taken by Jack Greathouse (left), Engine Committee chairman, and Wally Neumann, Instruments For Preventive Maintenance Subcommittee chairman.

Day at Aberdeen

CLIMBING A 30 IN. WALL is no trick for this three-axle, all-wheel-drive cargo truck. The truck is equipped with large single tires instead of the usual small dual wheels on the rear axles. This is because single tires with reduced inflation provide better mobility on beaches and desert terrain.

THIS IS NO PLACE for a passenger car! Aberdeen's frame twister can turn a truck into a three-wheeled vehicle. When the driver was asked how the course was to drive, he replied; "I don't drive it, I just follow the road."

GOING UP the 60% slope looks simple but until a vehicle has proven its ability, a picture like this can't be taken. New vehicles are always held in tow by a steel cable, anchored at the top, until brakes and transmissions are checked out.

"Vapor Locking" Highlighted At SRO Session of F&L Meeting

A THOROUGH airing of the increasingly complex "vapor lock" problem was a highlight of the SAE National Fuels & Lubricants Meeting, held at Tulsa, Okla., on November 5 and 6. At a standing-room-only session both passenger car and petroleum engineers presented their latest thinking on this controversial subject.

The two industries seem fated to have different concepts of what constitutes suitable volatility for gasoline. The car manufacturers want it low enough so the gasoline will operate satisfactorily in modern cars (with their high underhood temperatures). The petroleum industry, ever alert to using as much of the crude supply as possible, is trying to develop suitable fuels that contain as much of the lower cost — and also high octane — butane as feasible.

Progress reported at the meeting concerned ways of measuring the actual vapor tolerance of fuel systems as installed in vehicles, from sea level up to altitudes of 11,400 ft. When these methods were used with any large group of cars, a considerable spread was found between the "best" and the "worst" car. Moreover, there are still wide differences of opinion as to the tolerance value that can be considered safe to use.

In fact, one philosophy expressed at the meeting was that the individual car owner is the ultimate vapor-lock expert. This does not mean, of course, that all such tests should be dropped. They do, however, have minor significance, one discusser suggested, relative to the overwhelming evidence obtainable by appropriate interpretation of the characteristics of fuels marketed throughout the country at different seasons of the year.

Other papers at the meeting presented up-to-date material on antiknock ratings, abnormal combustion in high-compression engines, a multipurpose laboratory engine test, spark-plug deposits, intake valve underside deposits, and oil additives. Field tests using taxis and Ordnance vehicles to evaluate motor oils were also described and the results evaluated.

Chairmen of the sessions where these papers were presented and discussed were: L. A. McReynolds, Phillips Petroleum Co.; J. J. Mikita, E. I. du Pont de Nemours & Co., Inc.; E. J. McLaughlin, California Research Corp.; W. W. Schafer, Lubrizol Corp.

Capsule reports of all four technical sessions at the meeting appear on the next two pages

Explorer Siple

DR. Paul A. Siple, scientific adviser to the Director of Army Research, Office of Chief of Research & Development, spoke on "Stress of Environment on Men and Equipment during Man's First Winter at the South Pole" at the SAE Fuels & Lubricants Meeting dinner on November 5.

Siple began his polar activities 30 years ago when he went on Byrd's first expedition to Little America. He recently returned home, after having served as scientific leader of a group that spent a year right at the South Pole, as part of the IGY.

One of the men's first problems after arriving at the station was, he reported, to locate and drag in the equipment and supplies that had been parachuted into the vicinity, for the year's stay. They had two vehicles to drag in these supplies: a D-2 Caterpillar tractor and a Weasel.

This had to be accom-

W. L. Thompson (left), chairman of the host section, SAE Mid-Continent Section, poses with **Lloyd Withrow,** meetings vice-chairman of the SAE Fuels & Lubricants Activity Committee. A large share of the credit for the success of the technical program goes to Withrow and to **R. Wayne Goodale,** vice-president representing the SAE Fuels & Lubricants Activity, who was unable to be present at the meeting.

Relates Antarctic Experiences at F&L Meeting Dinner

plished during the summer, for the vehicles weren't used during the winter, when temperatures ranged to as low as – 102 F, with winds of 15 knots and more. He did report, though, that they managed, on one occasion, to run the D-2 when the temperature was – 90 F, after having started it in the garage.

Both machines were worked until they failed. The tracks and cables through them gave way on the Weasel.

Electricity for the camp was supplied with engines similar to that on the D-2. These engines operated satisfactorily during their whole stay at the Pole. Cost of diesel fuel, which was also burned in the space heaters used to supply warmth, was $10 per gal, delivered at the Pole.

Siple told about one difficult lubrication problem they ran into while trying to find out how close to the geographical South Pole the camp actually was.

Since the sun never goes higher than 22½ deg above the horizon at the Pole, to get accurate results it was necessary to shoot the stars. This meant using a theodolite during the winter when the temperature was – 90 to – 100 F.

At – 60 to – 70 F the bubble grew so large that it expanded into the housing. At – 90 F, the lubricant in the instrument seized. So, although the instructions said the theodolite was to be used at atmospheric temperature, it was necessary to warm it up to the point where it could be operated. They finally decided the camp was 2400 ± 100 ft from the Pole.

The stress of cold, he said, was harder on the equipment than it was on the men. At – 95 F to – 98 F one man spent 4 hr outside. At – 100 F several men stayed out for 2 hr at a time.

Participants at the dinner on Wednesday evening pose before the event: (left to right) Robert Cass, who was toastmaster; William K. Creson, SAE President; Dr. Paul A. Siple, who was dinner speaker; and F. E. Selim, general chairman of the Committee on Arrangements, who welcomed the guests to the dinner.

Capsule reports of all four technical sessions at the

Wednesday morning

fuel system vapor tolerance

All types of vehicle hot fuel handling characteristics, such as loss in engine power, momentary engine cut-out, complete engine stoppage, poor idling, stalling in city traffic, or poor hot starts, should receive equal attention, according to the authors, because any one could be the limiting factor with respect to customer satisfaction.

Hot fuel handling test results have good repeatability, provided the car preparation and test techniques are adequate, and any erratic vehicle performance not associated with hot fuel handling problems is detected and corrected during a test.

Adequate test instrumentation is necessary to determine erratic vehicle performance during a test, and to supply sufficient data so that a proper analysis can be made. (Paper 104A)

A practical method for describing the volatility tolerance of any given car fuel system is expressed by the equation:

$t_a + 115 \log(\text{Rvp} + \text{barometer drop}) + V(2 - S) = C$; where: t_a = atmospheric temperature, F; Rvp and barometer drop from 14.7 are in psi; S = one-tenth of the difference between ASTM distillation 10% and 20% temperatures; V = relative vapor-handling capacity of car fuel inlet system; C is best described as temperature tolerance constant of car fuel system.

The constant C has the same value regardless of the atmospheric temperature at which vapor lock tests are made. (Paper 104B)

During the summer of 1957, a vapor lock test was conducted in Colorado to determine the volatility tolerances of recent model passenger cars at various elevations. These tests showed that:

1. Most of the recent model passenger cars have well-designed fuel systems. These cars do not have hot fuel handling difficulties at high altitudes.
2. Two makes of cars and a particular model of another make have considerably lower volatility tolerances than the rest of the makes. If the fuel systems of these makes were improved, probably very little hot fuel handling difficulty would be encountered on the fuels now marketed in mountainous regions.
3. The fuel vapor pressure method appears to be quite satisfactory for expressing the volatility tolerances of all cars tested. This is particularly true for petroleum marketers, since it establishes volatility tolerance in terms of Reid vapor pressure directly and front end distillation indirectly. (Paper No. 104C)

Wednesday afternoon

abnormal combustion

Abnormal combustion was encountered while investigating combustion-chamber configuration in a high compression ratio single-cylinder engine. It manifested itself as an uncontrollable form of combustion occurring earlier and earlier in each subsequent engine cycle. This resulted in extreme engine power loss and a violent, audible noise. It has been termed runaway preignition.

The fundamental cause of runaway preignition has not been determined. It is promoted by engine design characteristics, such as high compression ratio and combustion-chamber geometry. This form of abnormal combustion responds to engine speed, load, spark advance, and fuel-air ratio. It apparently occurs in the absence of conventional surface ignition. Although runaway preignition does *not* appear to respond to the octane quality of the fuel, it does respond to fuels of different chemical structure. (Paper 105A)

antiknock ratings

Research octane ratings do not adequately define the antiknock performance of gasolines in cars on the road — gasoline sensitivity, composition, and other fuel properties also have effects. Specific correlation equations can express the effects of the fuel properties, but a different equation is needed for each car and speed. With the aid of simple statistics, the different equations can be combined to yield Customers' Antiknock Ratings (CAR).

The CAR of a gasoline is uniquely related to the percentage of cars the gasoline will power without knocking. Even in simplified form, CAR is much better than Research rating. According to the authors, the use of CAR improves comparisons of gasolines, quality control, evaluations of processes, and projections of future antiknock quality. (Paper 105B)

Two gasolines may have the same Research octane number, the same Motor octane number, and the same overall hydrocarbon composition, yet differ significantly in road antiknock performance. The authors conclude that such variation can be related to the placement of hydrocarbon types in the boiling range of the gasolines.

Specifically, the studies showed that the low-boiling olefins provided better road performance than did the high-boiling olefins. Also, low-boiling aromatics gave better road ratings than the high-boiling aromatics. The magnitude of these effects varied with vehicle engine speed. (Paper 105C)

multipurpose lab engine test

Suitable electrical equipment has been assembled that, when used with a dynamometer, automatically operates laboratory test engines according to road-load conditions. The engine is continuously put through periods of idling, acceleration, constant-speed, variable-load operation, and downhill coasting. The controller is readily converted for use with engines of different power outputs and for various combinations of engine operating cycles.

A laboratory engine test procedure has been designed that simulates road operation of passenger cars engaged in urban and suburban driving. This procedure permits the screening of a number of the more pertinent fuel-lubricant product quality performance factors in a single test procedure. The total test time has been shortened by eliminating periodic oil drains. While this means of accelerating engine deposit formation appears to be satisfactory in comparing the effectiveness of lubricants, its use should be limited to comparisons where the lubricant or lubricant additives are of the same general type. (Paper 105D)

Papers on which these capsules are based are available in full in multilith

1958 SAE National Fuels & Lubricants meeting . . .

Thursday morning

evaluating lubricants

More consistent results can be obtained in evaluating motor oils by means of field tests, if certain practices are followed, such as: use of laboratory engine dynamometer break-in for engines prior to their installation in test vehicles, controlling oil consumption, expressing oil consumption in terms of actual miles on the oil at time of drain, and using 3000 miles between oil changes (which duplicates the average motorist's oil change practice).

Such methods resulted in test overall sludge ratings that varied only about one-third as much and overall varnish rating variations of one-half those of an earlier test. There are, however, still many unknown facets to this type of operation. (Paper 106A)

engine deposits

The spark-plug fouling problem appears amenable to control by such means as: increased operating temperature, fuel additives forming less conductive lead salts, and fuels containing more heavy ends.

The fuel manufacturer has the last two avenues open to him. But he is unlikely to go too far in using the last-named one because of undesirable side effects, for example, increased engine deposits, surface ignition, and higher octane requirements. Fuel additives are likely to be used more and more to combat the fouling problem. Phosphorus-containing additives have proved very effective and are coming into more widespread use by the petroleum industry. (Paper 106B)

Although all mineral oil crankcase lubricants form intake valve underside deposits on overhead-valve V-8 engines, the rate of formation is generally more rapid with multigraded lubricants prepared from low viscosity base stocks and V.I. improvers. This tendency to form deposits is greater when the base stock is oxidized at high temperature.

The quality of deposits formed with a particular fuel-lubricant combination is a function of the quantity of lubricant that reaches the valve underside area. In the range of flow rates studied, increasing the flow rate of the lubricant to the rocker arm area increases the rate of deposit formation. Increasing inlet air temperature likewise increases deposit formation.

Since lubricating oil contaminants contribute to intake valve deposit formation, a definite advantage is indicated for the use of oil filters and frequent oil changes. (Paper 106C)

Reference engine oils REO-132 and REO-133 (10W-30 grade) have been run in two field tests — one by Ordnance at Aberdeen and the other by Standard Oil Co. (Ohio) at Cleveland. A comparison on the basis of engine service factor suggests that the operating conditions of the Aberdeen fleet were more severe than those of the Cleveland fleet, yet both fleets were considered to have operated under continuous low-load factor, light-duty, low-temperature, stop-and-go conditions. The question arises as to which degree of severity is more typical. If the degree of severity of the Aberdeen operation is at all typical, then polymeric-dispersants, as a class, are not necessarily effective in preventing sludge deposits in an engine. (Paper 106D)

Thursday afternoon

oil additives

Studies of low-temperature wear in a laboratory gasoline engine showed that SO_2 formed by combustion of the sulfur in the fuel and halogen acids from excess tel scavenger are the principal causes of corrosive wear. Wear depends on available alkalinity and surface protection characteristics of a wide variety of lubricant additives.

Some additives provide only alkalinity, others only surface protection, and some both. The effectiveness of surface protection depends on the type of acid molecule encountered. Surface protecting barriers exclude the larger SO_2 and bromine molecules more readily than the smaller chlorine molecule. (Paper 107A)

An interference microscope study showed that the operation of engine cams and valve lifters on oils containing zinc dithiophosphate additives can result in an increase in the small-scale roughness of the lifter-foot surface over that obtained by operation of the same parts on oils that do not contain the additive. In addition, the development of this surface roughness is also influenced by operating time, stability, and concentration of the additive, and composition of the contacting surfaces.

Although the mechanism involved is far from being completely understood, the increase in small-scale roughness is believed to result from a reaction of additive decomposition products and the surface. (Paper 107B)

The compound-type zinc dialkyl dithiophosphate has gained wide acceptance in the United States for high-quality motor oils. Other additives prevent oil oxidation and bearing corrosion, but they do not contribute antiwear or extreme-pressure characteristics to any appreciable extent. Some additives that give a high degree of antiwear protection are pro-oxidants, while others are corrosive to bearings. None are multipurpose to the extent of having the balanced performance of zinc dithiophosphate. (Paper 107C)

The antiwear action of zinc dialkyl dithiophosphate is related to three main types of wear: adhesive, abrasive or cutting, and corrosive wear. It has been shown that the additive molecule is specifically tailored to form a chemical film on the wear surfaces under the high load and temperature conditions existing in an engine.

It appears that, as the operating conditions become more severe, chemical activity of the additive is increased. In short, more protection is provided under high load and temperature conditions whether they exist during the initial stages of running or they occur in subsequent operation. Protection against the aforementioned wear types is afforded in three ways: faster mating of the contact surfaces through temperature controlled chemical polishing, formation of tightly adhered chemical films having antiwelding properties, and possibly the protection of more wear-resistant surfaces through selective chemical etching of the metal surfaces. (Paper 107D)

form from SAE Headquarters. See order blank on page 6.

What to do about

Airborne Electronic

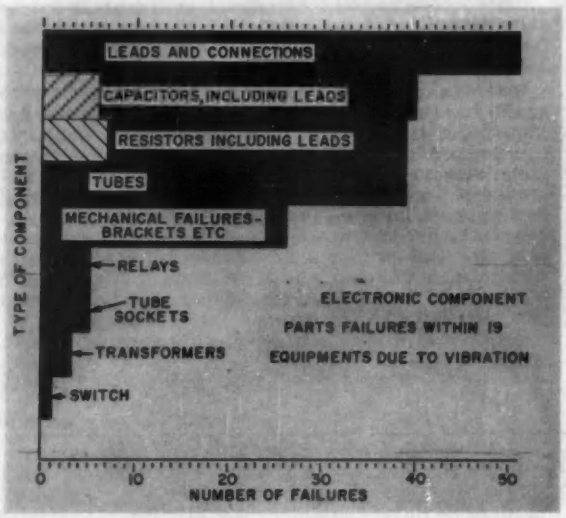

Fig. 1 — When components are assessed for their contribution to the poor fragility rating, lead failures are found to account for 50%. Simple techniques would alleviate this situation.

Based on paper by

Carl A. Golueke

Wright Air Development Center

TWO AVENUES are open to the designer to reduce airborne electronic part failures due to vibration. He can use standard equipment and isolate it against vibration or he can make the part more rugged. The choice depends largely on the type of aircraft (or missile) and the local vibration level.

The compromise involved in using isolators normally is the additional space required for displacements. This is important because the extra cubic content may be as high as 50% of the original volume of the equipment, due to the dimensional aspects occurring at the outermost perimeters of the equipment. The additional space can be decreased by using isolators to support several combined equipments, such as the installation of isolators between structures and complete shelves containing several equipments. A 20% space saving in relation to separate mountings often can be obtained in addition

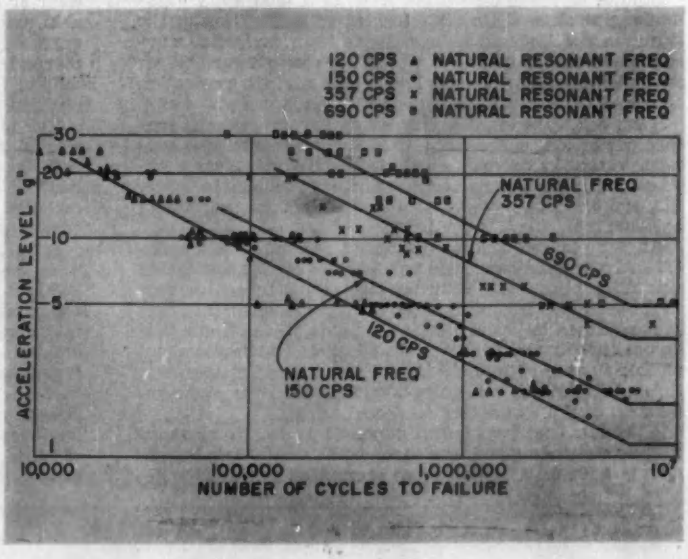

Fig. 2 — In this plot of resistor fatigue failures, all curves are results of fatigue resonance tests and the four separate resonant frequencies are merely the same type of resistor with the lead length changed.

Component Failures

to the comparative convenience of isolating larger elements. There is a distinct trend in this direction.

Ruggedizing As a Way Out

Making equipment more rugged to withstand the environment without the benefit of isolators also involves compromise, mainly in the weight penalty area. This is due mostly to heavier chassis construction, potting techniques, and economy. Whether to ruggedize equipment for use without isolators, or to use standard equipment with isolators, depends upon the type of aircraft. For transports and bombers, the additional space required for isolating equipment may not be critical. For fighter aircraft and small, compact missiles, the added weight may be the critical feature. When considering these aspects, the total volume and weight of electronics in relation to the size and weight of the overall vehicle is important.

The fragility level of most currently used airborne electronics, those developed in the past, is probably lower than 2*g*. Fig. 1 indicates the elements and to what degree they contribute to the poor fragility rating. The portions of the solid columns related to the resistor and capacitor components show the lead failures. These added to other lead failures create the greatest headache (50%). The simple technique of clamping, shortening leads, or bonding would alleviate this condition. The failures of these components are not in the primary frequency response area of the component itself; they are due to the effects of the high response (*Q*) of the chassis. It should be noted that electron tubes have an unreliable index as a component part.

Evaluation of Fragility

When considering and evaluating fragility levels of equipment, it is necessary to scrutinize the final

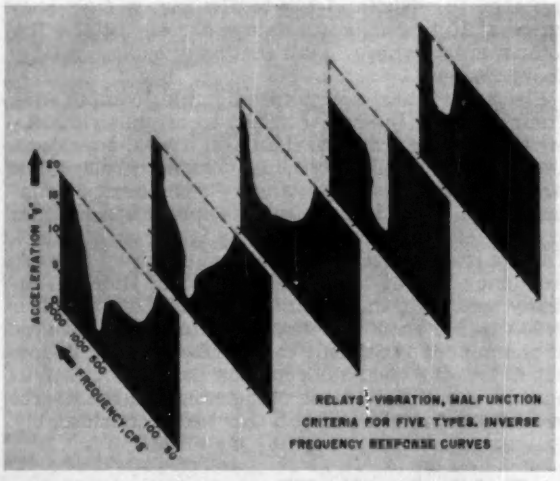
ACCELERATION "g"
FREQUENCY, CPS
RELAYS' VIBRATION, MALFUNCTION CRITERIA FOR FIVE TYPES. INVERSE FREQUENCY RESPONSE CURVES

Fig. 3 — Fragility indices for five types of relays. Relays can now be had which will be superior to that shown at the extreme right.

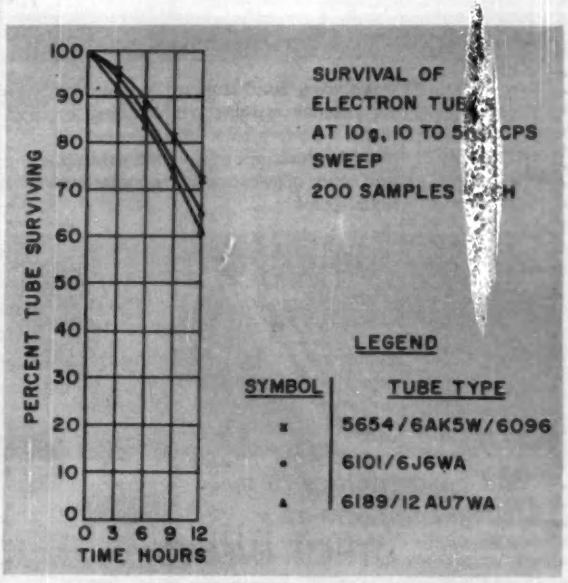

Fig. 4 — Great variety of types, functions, and physical applications of electron tubes makes difficult the establishing of a fragility index. These curves indicate a per cent survival on a sweep frequency test of 10g over a period of time.

plan now to attend the

SAE ANNUAL MEETING

JAN. 12-16, 1959

SHERATON-CADILLAC AND STATLER HOTELS, DETROIT

featuring sessions on

ENGINES, FUELS, LUBRICANTS

V-type diesels; exhaust cleanliness of diesels; carburetor icing; fuel component distribution; progress report from AMA Combustion Products Committee; wear theory and testing; turbine fuels; fluoroester oils for high-temperature lubrication . . .

CARS, TRUCKS, EARTHMOVERS

effects of higher engine speed and power on clutches, transmissions, and rear axles; automatic transmission fluids; aluminum brake drums and gray iron brake drums; European independent rear suspensions; design of light-weight highway tractors; the passenger car of 1980; brakes for tractors and construction equipment . . .

MISSILES AND AIRCRAFT

powered ground support equipment for missiles and aircraft; shielding for nuclear powerplants; development of radiation-resistant equipment; cermets and other high-temperature materials; aerial jeeps . . .

PLUS THE 90 BOOTH

ENGINEERING DISPLAY

showing the latest in materials; fasteners; filters; fuel injection equipment; engines; engine mounts; heaters; instrumentation . . .

and opportunities to meet fellow engineers at

OTHER EVENTS

- SAE Annual Dinner
- Technical Committee meetings
- Headline luncheons

(continued from preceding page)

electronic component parts as to their individual fragility level. It is extremely tricky to design equipments beyond the susceptibility level of the weakest component part. It can only be done by placing the part in the high chassis attenuation region of the response, or by use of individual isolating mediums.

The component part by itself is usually much more rugged than the overall equipment. This fact has been established by experimentation in which the component parts have been inserted and bonded into magnesium castings to establish a very rigid system. Successful systems have been realized which will withstand 20*g* to 40*g*. Another reason for this greater ruggedization is the more stringent requirements which have been placed on component parts.

When considering families of component parts, the resistor and capacitor often can be treated in a simple fashion if they are lead mounted. Fragility levels can be estimated; because of fatigue parameters, the level has a time and *g* variable. This is indicated in Fig. 2, which presents the typical SN type of data except that actual acceleration levels have been used.

Relays As a Source of Trouble

Fig. 3 indicates fragility indices for five types of relays. These data are based on relays when placed in their most vulnerable situation (orientation and normally closed contacts). Since these data were obtained, amazing ruggedization has been achieved and today it is not difficult to obtain a relay that will surpass the type found at the extreme right of Fig. 3.

When evaluating the fragility of relays, the malfunction criteria must be used instead of fatigue. Actually, a combination condition exists whereby a relay may deteriorate gradually in function when subjected to vibration. In general, relays may be expected to withstand 10*g* to 15*g* over a frequency range of 10 to 2000 cps. Relays are one of the few components whose malfunctions occur mainly above 500 cps.

Electron tubes are unpredictable components. Their fragility index is difficult to establish mainly because of the great variance of types, functions, and physical applications. But, as with relays, the state of the art is improving. In the area of ruggedization, probably the most appropriate manner of describing their susceptibility is shown in Fig. 4. These curves indicate a per cent survival on a sweep frequency test of 10*g* over a period of time. Generally speaking, the natural frequency of the tubes is 200 to 300 cps. The failure criteria of this type of component is difficult to describe because it does not follow the clear malfunction pattern or fatigue phenomenon. One must first determine the degree of malfunction allowed and this varies considerably.

To Order Paper No. 83D . . .
. . . on which this article is based, turn to page 6.

Ground Support Equipment Can Be 90% of Total Cost

FIFTY to 90% of the dollars spent on a missile weapon system is reported to be the appropriation for ground support equipment. At the 1959 SAE Annual Meeting, SAE members will have the opportunity to become better acquainted with this new industry that is joining the SAE family. Since ground vehicle engineers and suppliers are being called upon to develop and manufacture support equipment from voltmeters to missile transporters and launchers, several technical sessions outlining support equipment requirements have been planned. A feature on Tuesday morning, January 13, will deal with ground power for aircraft and missiles, while the Monday evening, January 12, program will include a paper on ground support equipment for rockets and missiles.

Airline transportation also requires a great many pieces of ground support equipment including vehicles to move passengers from city centers to the airports, self propelled passenger and cargo ramps, lift trucks, tractors, and maintenance vehicles. Functional requirements, design, and early experience for turbine transports will be discussed at an afternoon technical session on Wednesday, January 14. Passenger transport from city centers to airports will be the topic of a Wednesday morning program.

YOU'LL . . .

. . . be interested to know . . .

Dream Car? The engineer's vision of new technical developments become a reality in the Firebird III. Details of chassis, body, controls, and engines will be exposed and analyzed on Thursday evening, January 15, at SAE Annual Meeting.

1936 is reported to be the start of the modern era of automobile styling. Projections of body features in 1980 will be featured on Tuesday evening, January 14, immediately following the Annual Business Meeting of the Society.

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Rapid technological advancements impose an unending burden on the fuels and lubricants engineers, designers, and users. Three technical programs at the 1959 SAE Annual Meeting focus on current problems. **Carburetor icing control** and the use of **radioactive tracers** in determining fuel distribution will be subjects reviewed in the fuel volatility session on Tuesday morning, January 13.

An afternoon program will explore **aviation fuels and lubricants** such as new fluoroester oils for high-temperature applications, fuel variables, and selection of materials for use with synthetic hydraulic fluids.

The design, evaluation, and comparison of bench tests with actual performance of automatic transmission fluids shall be subjects discussed on Wednesday, January 14.

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Florida or Alaska — Maine or California . . . where will your new vehicle be required to operate? Each year as new materials and processes are developed, new weather problems are presented. How can the engineer accumulate sufficient data on the effects of driving snow, boiling sun, salt air, heavy rains, and dust, without expending considerable time and money. "Bringing Outdoor Testing Indoors," a technical session on Thursday, January 15, at the 1959 SAE Annual Meeting, will include description of several simulated testing procedures now employed.

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H. E. Chesebrough has been appointed SAE's representative on the Board of Directors of the American Standards Association. He will serve for two years, starting January, 1959.

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Applications in September climbed to a new high of 330. This not only compares favorably with last September's figure of 311, but is the first time since January that 1958 monthly applications have been higher than the same month of 1957. This 1958 figure is the highest since September of 1954. But, October applications fell behind last year's after this encouraging September record.

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75% of the SAE Members registered with the SAE Placement Service in 1958 made new connections as a result of their listing. Eleven percent were placed through other sources. The remainder decided to remain with their own companies.

At the 1959 SAE Annual Meeting . . .

Activity Business Sessions

The following is the schedule established for the Activity Business Sessions, to be held at the 1959 SAE Annual Meeting in Detroit, January 12–16.

Air Transport	Wednesday, 2:00 p.m., Bagley Room, Statler
Aircraft	Tuesday, 2:00 p.m., Michigan Room, Statler
Aircraft Powerplant	Monday, 2:00 p.m., Grand Ballroom, Statler
Body	Tuesday, 8:00 p.m., Grand Ballroom, Sheraton-Cadillac
Diesel Engine	Monday, 2:00 p.m., Grand Ballroom, Sheraton-Cadillac
Engineering Materials	Wednesday, 2:00 p.m., Grand Ballroom, Statler
Fuels and Lubricants	Wednesday, 9:00 a.m., Grand Ballroom, Sheraton-Cadillac
Passenger Car	Thursday, 2:00 p.m., Grand Ballroom, Sheraton-Cadillac
Production	Friday, 9:30 a.m., Grand Ballroom, Statler
Tractor & Farm Machinery	Friday, 9:30 a.m., Michigan Room, Statler
Transportation & Maintenance	Thursday, 9:30 a.m., Grand Ballroom, Sheraton-Cadillac
Truck & Bus	Friday, 9:30 a.m., Grand Ballroom, Sheraton-Cadillac

11 Aero Querries on PFP Get Answers from J. H. Famme

in this article . . .

. . . SAE Councilor J. H. Famme retells for readers of SAE Journal his responses to questions about Society operations under the Planning for Progress proposals.

A vice-president representing Aircraft Activity before beginning his current 2-year term as Councilor, Famme is also a member of SAE's Planning for Progress Committee. He is works manager, Plant 2, Convair Division of General Dynamics Corp., San Diego, Calif.

J. H. Famme

FIVE of the eleven questions raised by members of the three SAE aeronautic Activity Committees concern relationships between the Activity Committees and the Engineering Activity Board and the SAE Board of Directors.

Perhaps it's easier to understand this relationship if one keeps in mind the idea that in the proposed new setup, authority flows down from the top instead of building upwards haphazardly.

The President, with the approval of the Board of Directors, names the members of the Engineering Activity Board to three-year terms and appoints the Board chairman. (August 28, 1958 draft of the By-Laws, C 31) Suggestions to the President regarding appointments from members of the Society are, of course, more than welcome. In fact, it is expected that a practice will be made of encouraging such suggestions.

The Engineering Activity Board decides what Activity Committees to set up and names their members initially. (Chances are, the Board will start with the membership lists as they are for existing Activity Committees.) The Board also appoints from among its members a sponsor for each Activity Committee. It would be the sponsor's duty "to provide liaison . . . and to advise with respect to committee personnel."

This is the system used now by the Technical Board. The usual practice is for the Technical Committee chairman to keep watch for suitable men to serve on his Committee and mention his choices to the sponsor. The sponsor gives his OK, and the chairman issues the invitation. The system has worked well for the Technical Board and Committees.

The members of each Activity Committee will nominate their own Committee chairman each year for Board approval.

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Here are the five questions regarding the relationship of the Activity Committees and the Engineering Activity Board:

Q. Will the chairman of the Engineering Activity Board be a member of the SAE Board of Directors?

A. No — unless he happens to be nominated and elected as a Director the same year as he is named to the Engineering Activity Board. However, "the Chairmen of each of the three Boards may attend meetings of the Board of Directors and take part in discussions affecting the work of his Board but shall not have a vote."

Q. Are the Activity Committees necessarily represented on the Engineering Activity Board?

A. Each Activity Committee is represented through its sponsor on the Engineering Activity Board.

Q. Will the chairman of each Activity Committee be a member of the Engineering Activity Board?

A. No, not automatically. He might happen to be named chairman of an Activity Committee at a time when he was a member of the Board. But as the Activity Committees become more and more active, an Activity Committee chairman will find his time pretty well taken up with directing the technical interests of his Activity.

Q. Does the chairman of an Activity Committee participate in selection of his Committeemen?

A. Technically the Engineering Activity Board makes the selections, counting heavily on the aid of the Board sponsor of the Activity Committee. In practice, however, it's likely that the sponsor will ask the help of the chairman, and that the chairman will be most influential in the selection of Committee members.

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Two of the questions concerned the timing of the transition. This is a matter to which the staff has given considerable attention. An elaborate timetable has been worked out. (A greatly simplified version of it takes five typewritten pages!) Members can be assured that ways have been figured out of accomplishing the transition in an orderly fashion. For anyone who is interested in the detail, it's available. Meanwhile, here are the two questions which have been raised:

Q. When will the new organization go into effect?

A. The plan is to put the new structure into effect at the beginning of the 1960 administrative year — that is, in January, 1960. (Assumed here is letter ballot approval by the SAE membership of the Constitutional amendments required to bring about the Planning for Progress organization. This letter ballot probably will be mailed to the members in February, 1959, assuming the amendments get favorable reception at the Annual Business Meeting this coming January.)

Q. How and when will the transition be made from the present method of nominating Vice-Presidents to the new method of nominating Directors?

A. If the Constitutional amendments are approved, the men nominated by the Activity nominating committees as Vice-Presidents would be shown on the ballot for election of officers as Directors, to serve as Directors on the 1960 Board of Directors.

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Two more of the questions relate at least in part to the Technical Board.

Q. Is anything being done to end the requirement that all members of the

Official Notice

THE Annual Business Meeting of the members of the Society of Automotive Engineers will be held on Tuesday, January 13, 1959, at 8:00 p.m., at the Sheraton-Cadillac Hotel, Detroit, Mich., as part of the Annual Meeting of the Society.

Technical Board be asked to vote on a proposed standardization document? Obviously, no member can be sufficiently well versed in all fields of automotive engineering — both ground vehicle and flight vehicle engineering — to be a competent judge of all the Society's standards.

A. Yes, the Technical Board does plan to change its rules so that aircraft men won't be asked to vote on ground vehicle standards and vice versa. The plan is to interpose "Councils" between the Board and its Committees. There may, for example, be an aeronautical Council made up of three or more Board members competent in that field which will approve or disapprove aeronautical standards and no others. The Technical Board will still have the final word, but the Councils will have power to approve reports when there are no dissenters.

Q. If Activity Committees are going to set up subcommittees to explore technical questions and issue technical reports, isn't there a chance of duplicating work under way in SAE Technical Committees?

A. It's conceivable. But, with the staff maintaining good liaison between the Activity Committees and the Technical Committees, such duplication can be avoided.

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The remaining two questions are:

Q. Will there be a membership vice-chairman on each of the Activity Committees — or how will membership promotion be handled?

A. To concentrate on its key function of information development, the Activity Committee will be freed of membership promotion work. The work will, however, be pursued vigorously under a Membership Committee, which will be a standing committee reporting directly to the SAE Board of Directors. There will be liaison between the Membership Committee and the Engineering Activity Board and its committees on membership matters. The Membership Committee will seek cooperation from special groups on special membership projects.

Q. Will information on the new SAE organization be distributed to management of interested companies?

A. This hasn't been attempted, but your suggestion is being passed along to Bill Ford of Continental Oil, who is handling the "educational" effort for the PFP Committee. So far, the emphasis has been to spread the word to the active members of the Society, as the most interested parties. Actually the changes are not very great and might not seem really significant to other than members. Maybe even to members the changes are not so drastic as might be assumed from the thorough airing that has been given them. But it was felt that the Society belongs to its members, and every one of them should have an opportunity to say how he wants his Society to be run.

. . . at 1959 SAE Annual Meeting

two floors of **Engineering Display**

The latest in:

• materials • engines • driveline components
• fasteners • electrical and hydraulic systems
• controls • bearings

. . . and other advances will be included in the 100-booth engineering display that will complement the technical sessions at the 1959 SAE Annual Meeting. On the Fourth Floor of the Sheraton-Cadillac Hotel and one flight down in the English Room on Mezzanine Floor, the display will be open on Monday, Tuesday, and Thursday from 9:00 a.m. to 8:30 p.m., on Wednesday from 9:00 a.m. to 5:30 p.m., and Friday from 9:00 a.m. to 4:00 p.m.

SAE National Meetings

• January 12–16, 1959
Annual Meeting and Engineering Display
Sheraton-Cadillac and Statler Hotels
Detroit, Mich.

• March 16–18, 1959, National Passenger Car, Body and Materials Meeting, The Sheraton-Cadillac, Detroit, Mich.

• March 19–20, 1959, National Production Meeting, The Sheraton-Cadillac, Detroit, Mich.

• March 31–April 3, 1959, National Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display, Hotel Commodore, New York, N. Y.

• June 14–19, 1959, Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

• August 10–13, 1959, National West Coast Meeting, Hotel Georgia, Vancouver, B. C., Can.

• September 14–17, 1959, National Farm, Construction, and Industrial Machinery Meeting, Production Forum, and Display, Milwaukee Auditorium, Milwaukee, Wis.

• October 5–10, 1959, National Aeronautic Meeting, Aircraft Manufacturing Forum and Aircraft Engineering Display, The Ambassador, Los Angeles, Calif.

• October 26–28, 1959, National Transportation Meeting, La Salle Hotel, Chicago, Ill.

• October 27–28, 1959, National Diesel Engine Meeting, La Salle Hotel, Chicago, Ill.

• October 28–30, 1959, National Fuels and Lubricants Meeting, La Salle Hotel Chicago, Ill.

SAE Section Meetings

CENTRAL ILLINOIS

January 26 . . . "Diesel Engine Design." Pere Marquette Hotel, Peoria, Ill. Dinner 6:30 p.m. Meeting 7:45 p.m.

CHICAGO

January 26 . . . "The New Studebaker Light Car." LaSalle Hotel, South Bend, Ind. Dinner 6:45 p.m. Meeting 8:00 p.m.

CLEVELAND

January 19 . . . Fuels and Lubricants Meeting. Cleveland Engineering & Scientific Center, 3100 Chester Ave.

METROPOLITAN

January 8 . . . George T. Coker, Jr., Shell Oil Co. "Civil Aviation Turbine Fuels." Brass Rail Restaurant, Fifth Ave. between 43rd & 44th Sts., New York City. Cocktails 5:30 p.m. Dinner 6:30 p.m. Meeting 7:45 p.m.

MONTREAL

January 19 . . . L. J. Stypinski, Canadair Ltd., Montreal. "The Development of the RAT." Sheraton-Mount Royal Hotel.

PHILADELPHIA

January 7 . . . Aircraft Activity Meeting. The Engineers' Club, 1317 Spruce St. Dinner 6:30 p.m. Meeting 7:45 p.m.

SPOKANE-INTERMOUNTAIN

January 21 . . . D. D. Collins, specialist, Lubricants Division, Standard Oil Co. "Heavy Duty Lubricants." Desert Caravan Inn, Spokane. Dinner 7:00 p.m. Meeting 8:00 p.m.

WASHINGTON

January 20 . . . J. E. Hart, mechanical systems engineer, Lockheed Aircraft Corp., Marietta Division. "Engineering Problems in Space Craft." Occidental Restaurant, Pennsylvania Ave. Dinner 6:30 p.m. Meeting 8:00 p.m.

Rambling . . . THROUGH

The first moon colony

will be housed in empty fuel tanks from the craft that delivered them there, suggested Captain Robert C. Traux of the Department of Defense's advanced research project agency at **DETROIT SECTION.** Traux also told the engineers that he thinks the function of humans in space craft will be to change radio tubes and keep the complicated electronic equipment operating — rather than guiding the space ship or observing and recording data.

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Acceleration of the Lister-Jaguar is from 0 to 60 mph in 4.6 sec . . . as compared to the average Ford, Chevrolet, Plymouth, etc., which accelerates from 0 to 60 mph in approximately 12 sec. **DAYTON SECTION** Speaker C. Gordon Bennett from Jaguar Cars Inc. also reported the Lister-Jaguar goes from 0 to 30 mph in 2 sec, from 0 to 100 mph in 11.2 sec, and from 0 to 120 mph in 15.2 sec.

Bennett, vice-president, sales, of Jaguar Cars, made his presentation on the history Jaguar Cars Ltd. and the XK Engine and D-Type racing car.

Pre-meeting discussion included, left to right, Elton S. Moyer, Section chairman; Speaker Bennett; and George W. Jackson, section engineer, Delco Products Division, GMC.

THE SECTIONS

Kenneth Magee, director of engineering, J. I. Case Co., explains features of "Case-O-Matic" transmission at **TWIN CITY SECTION'S** October meeting.

Description of an analog-digital numerical control system, as applied to three and four axes of a milling machine, was covered at **CLEVELAND SECTION'S** October meeting. Speaker Paul H. McGarrell of Thompson Product's staff research and development, outlined steps of preparation and the succeeding application of punched tape to control and operation of a milling machine.

Speaker McGarrell, left, is shown with E. F. Gibian, staff director, industrial engineering, Thompson Products; A. T. Colwell, vice-president of Thompson Products; and Section Vice-Chairman E. H. Scott.

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Apprenticeship for American automobile mechanics is much shorter than service training in other countries, W. F. Gentle of England's Standard Triumph Motor Co., told **STUDEBAKER-HUDSON SECTION** in October. Basic reason, he said, is that American mechanics seldom have to work on foreign cars, whereas mechanics of other countries must work on cars from many nations.

Standard Triumph's service training program consists of one-day schools for mechanics of a small locale held once every three or four weeks. (Shop operators were reluctant and seldom able to release their men for more frequent training classes.)

Each day only one major topic is discussed, i.e. brakes, over-drive, engine tune-up, followed by a motion picture and actual work on the subject under study.

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If the width of a fine pencil line represented the height of a bar for the power of the largest single weapon in use in 1943 . . . a bar representing the power of the largest single weapon of today, plotted on the same scale, would extend higher than the General Electric's 50-story skyscraper in New York City. ("The Bean, The Cod, and Mr. Mach," by H. T. Hokason, manager, T-64 turboprop engine project, small aircraft engine department, General Electric Co., at **NEW ENGLAND SECTION,** October 7.)

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There is in this country, at the present time, no desperate need for atomic power at any cost. However, stated O. C. Kebernick of Westinghouse Electric's atomic power department, the "natural pace of nuclear development" has been accelerated in this country to assist and strengthen the economies of our allies. The most immediate **commercial application** of atomic power is in electric power production. (**PITTSBURGH SECTION,** October 28.)

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Fifth Annual Air Conditioning Forum of the **TEXAS SECTION** drew a total attendance of 330 — with 31 per cent from outside the state of Texas. Coast-to-coast representatives included engineers from 20 states, with highest registration from Texas (227), Michigan (16), Wisconsin (11), Kansas, and Ohio (9 each).

The three-day forum was expanded this year to include aircraft as well as ground vehicle air conditioning sessions.

Golf trophy for low gross score went to **MONTREAL SECTION'S** Don Seymour at the Section's first annual golf tournament and dinner. Winner Seymour, left, receives his award from Section Chairman David J. Monro, right.

About SAE Members

Kohr

Pretz

ROBERT F. KOHR, recently retired as director of Ford's Testing Operations Office, has been named assistant to the president of Palmer Products Corp., manufacturer of specialty adhesives. Kohr has held important engineering posts in the automobile industry for many years. He joined Ford shortly after World War II, was placed in full charge of research in 1948. Later he became executive engineer and then director of Ford's general engineering office. He was 1956 chairman of SAE's Technical Board; and in 1955 served as SAE vice-president representing Passenger Car Activity.

PHILIP H. PRETZ has been appointed director of the Testing Operations Office, Ford Motor Co. Engineering and Research Staff. He had been executive engineer of the vehicles testing office for four years prior to his new appointment. He joined Ford in 1946 after five years with Chrysler Corp. as an experimental engineer. From 1928 to 1941 he had been with Cadillac Motor Car Co.'s engineering department. Pretz is 1358 SAE vice-president representing Passenger Car Activity. He succeeds **ROBERT F. KOHR.**

Williams

Holaday

SELDEN T. WILLIAMS was appointed president and general manager of Scovill Mfg. Co. He has been a vice-president of Scovill since 1944. Williams joined Schrader, a division of Scovill, in 1929 and became a member of the Scovill Board of Directors in 1956.

Eddy

Spotz

WILLIAM M. HOLADAY has been appointed chairman of the civilian-military liaison committee set up under the national aeronautics and space law passed by Congress earlier this year. Holaday has been in the Department of Defense since May, 1957. Since November, 1957, he has been serving as the department's director of guided missiles — a post in which he will continue to serve. He was 1943 SAE vice-president representing Fuels and Lubricants Activity.

Riley

Pace

SAE PAST-PRESIDENT W. PAUL EDDY, chief of engineering operations, Pratt & Whitney Aircraft, Division of United Aircraft Corp., gave the annual William Park Woodside Lecture before the American Society for Metals meeting on October 13 in Detroit. Eddy's topic — the Aircraft Engine, a proving ground for new materials — will cover materials and processes used in the aircraft engine industry. He also discussed heat resisting alloys, titanium alloys, bearings, and electroplating developments. Eddy also was 1955 SAE vice-president representing Engineering Materials Activity.

DONALD R. SPOTZ has been made president and general manager of Pesco Products Division and Wooster Division, Borg-Warner Corp. Previously, he was vice-president in charge of sales for Pesco Products Division. Spotz has been directly associated with the design, manufacture, and sale of aircraft and industrial accessories since 1941. Prior to joining Pesco late in 1955, he was sales manager for Accessories Division, Thompson Products, Inc., in Cleveland, and was active in sales and engineering work at Thompson for 14 years.

EDWARD P. RILEY, vice-president of Thompson Ramo Wooldridge Inc. has been named to supervise all of the company's automotive original equipment and replacement parts activities in the U. S. Riley directed the Tapco Group of divisions of Thompson Products, Inc., before Thompson merged with Ramo Wooldridge.

STANLEY C. PACE, vice-president of Thompson Ramo Wooldridge Inc., who has been assistant manager of the Tapco Group, succeeds Riley as manager of that operation.

JAMES H. COOLIDGE, vice-president of Thompson Ramo Wooldridge Inc., who, in addition to his responsibility for corporate financial matters has also directed the company's automotive replacement operations for many years, has been named chief fiscal officer.

Coolidge

Caserio

Willsey

Matthaei

Robers

Ross

MARTIN J. CASERIO is now general manager of Delco Radio Division, General Motors Corp. Caserio has been manager of the Milwaukee, Wis., operations of GM's AC Spark Plug Division since September, 1957. He joined GM in 1937, doing metal research work with AC in Flint, Mich. During World War II he served with the Army engineers. In 1953 he was named AC's chief engineer of automotive products. In 1956, he became director of engineering and equipment sales for AC.

BRUCE A. WILLSEY was appointed vice-president and general manager of the Des Moines plant of Solar Aircraft Co. Willsey joined Solar in 1949. He was manager of the manufacturing division at the San Diego plant and assistant plant manager of the Des Moines plant before becoming Des Moines plant manager in 1956.

FREDERICK C. MATTHAEI, JR., will head the new Engineering Science Division, American Metal Products Co. as vice-president of research and development. Formerly, he was secretary and sales engineer of the company.

GENE P. ROBERS has become vice-president of after-market sales of Carter Carburetor Division, ACF Industries, Inc., **CHARLES E. HEITMAN**, Carter president, announced. The staffs of the after-market sales, export sales, advertising and promotion, and service departments will report to Robers.

FRANK ROSS has been made vice-president of sales of E. F. Houghton & Co. Formerly, he was assistant to the vice-president of sales of the same company. He joined Houghton in 1942 as divisional manager of lubrication and became national manager of lubrication sales shortly afterward.

IRVING WHITEHOUSE has been named assistant director of research of Republic Steel Corp. He will direct activities at the Republic Research Center in Independence, Ohio. Whitehouse had been manager of Process and Product Development Division of Republic.

HOWARD C. BEYER has been made general manager for all divisions of Jeta Metal Fabricators, Inc. Beyer has been general manager of Jeta's Power Equipment Division.

SAE's PRESIDENT WILLIAM K. CRESON is now a full-fledged member of The Marlin Club of San Diego. Here at the weighing station he views his 124 lb catch, landed off North Island in 3 hr and 45 min, on Oct. 7. With him (left to right) are Bert King; Capt. Polly King of "Topajo II"; and SAE Member Robert A. Garrison.

De Soto's chief engineer **A. ELLIOTT KIMBERLY** was luncheon speaker at the Automotive Press Club in New York recently. Fuel economy, he said, is a major feature of today's cars, despite their larger and more powerful engines. Another significant plus is that these engines can be operated normally at relatively lower cruising speeds — and at only a fraction of their rated maximum output. Development of improved technology in the handling and use of light metals, he believed, will go a long way toward solving the problem of weight reduction.

LESLIE J. O'DONOGHUE has been made district manager of automotive products of Mobile Hydraulics Division, Vickers, Inc. Prior to this, he was a service engineer for Ford Motor Co.

PETER C. KING has been made professor of machine design at Queens University, Canada. He was formerly head of the mechanical engineering department for the Royal Military College, Canada.

EUGENE J. MANGANIELLO has been appointed associate director of Lewis Research Center, National Aeronautics and Space Administration (formerly the National Advisory Committee for Aeronautics). He had been assistant director of Lewis Laboratories, now called the Lewis Research Center of NASA.

CHARLES A. SERENO executive vice-president of Electronic Communications, Inc., St. Petersburg, Fla., has been named head of its Air Associates Division, the wholesale aviation supplies organization of the company.

JOHN B. BECKWITH has been appointed to the new post of engineering manager of Wallace Barnes Division, Associated Spring Corp. Formerly, he

continued

Whitehouse | Beyer | Kimberly | O'Donoghue | Manganiello | Sereno

HAROLD LUTHER ATWOOD (M '42) of Las Vegas saw to it personally that SAE got into the limelight recently when the 1958 USAF Worldwide Fighter Weapons Meet was held in his home town. He set up and manned the SAE exhibit shown here. It was part of the many displays of the latest Air Force and aviation industrial equipment held in connection with the meet at Nellis Air Force Base. The meet consisted of competitive events as well as in-action-flying displays demonstrated by top USAF and industry pilots. Atwood is a consultant to the First National Co. of Nevada.

SAE Members Say:

Dr. Robert F. Thomson

of General Motors Research **Says**

Sand Molding Unlikely For Aluminum Engines

"AT the present time, sand molding appears most uneconomical." That's what Dr. Robert F. Thomson of GM Research said in a recent Gray Iron Founders' Society discussion of the various methods available for the casting of aluminum engines.

With die casting, permanent mold, and semipermanent mold methods to choose from, he stated, "ultimate economics will finally determine the molding method." Indications are that aluminum is now competitive with iron from a cost standpoint.

Dr. Thomson said wear-resistant aluminum alloys, including high silicon materials, have shown satisfactory wear characteristics both in dynamometer and field tests with experimental V-8 engines.

He reported that GM Research had investigated various cylinder bore coatings, including chromium plate, iron plate, electroless nickel plate, oxide-type coatings, sprayed steel, sprayed molybdenum, sprayed aluminum and its alloys.

"These have shown varying degrees of promise," he commented. But 100,000 miles of test driving indicate several possible solutions to wear and score problems under normal driving conditions.

"In the event none of these (coatings or alloys) finally meet all requirements, one can always rely on . . . a cast iron (cylinder) liner, although this is not the ideal solution and will not achieve the goal of maximum weight reduction at minimum cost. We do not believe . . . cast iron as a bore material will finally be necessary."

was a product engineer for the company.

DAVID E. WAITE, chief product engineer, has been assigned to the factory manager's staff to work on special assignments.

ROBERT H. YEAKEY is now associate engineer of Boeing Airplane Co. Formerly, he was sales technical service engineer of Humble Oil and Refining Co.

E. RICHARD COOPER has been named field engineer of Chandler-Evans, Division of Pratt & Whitney Co., Inc. He will be stationed at the company's Hollywood, Calif., office. He was formerly sales engineer for Pacific Division, Bendix Aviation Corp.

EARL M. BARDEN has been appointed special sales engineer in Detroit for Electric Auto-Lite Co. Formerly, he was director of technical services for Huppower Division, Hupp Corp.

WILLIAM J. BIRD was made assistant general sales manager, general sales office of Chrysler Corp. He was formerly executive assistant for Chrysler Corp.

GEORGE K. ISAACS has become an electrical engineer, development engineering section of D. W. Onan & Sons, Inc., of Minneapolis, Minn. Prior to this, he was production engineer for Aeronautical Division, Minneapolis Honeywell Regulator Co.

Obituaries

J. LANSFORD McCLOUD . . . (M'44) . . . consulting director, manufacturing research, of Ford Motor Co. . . . retired August, 1956 . . . since retirement had been consulting editor for "Metal Progress" . . . was 1948 SAE vice-president representing Engineering Materials Activity . . . died July 26 . . . born 1891.

THEODORE BARGMAN . . . (A'46) . . . president and founder of Theodore Bargman Co. . . . died October 20 . . . born 1892.

CHARLES B. SPASE . . . (M'43) . . . chief engineer automotive development of Lipe-Rollway Corp. . . . died October 9 . . . born 1893.

PAUL S. DEAN . . . (M'51) . . . automotive lubrication engineer of Texas Co. . . . died October 12 . . . born 1893.

HERBERT G. FREESTON . . . (M'54) . . . chief engineer of Shell Research, Ltd., England . . . died July 29 . . . born 1912.

Continued on Page 102

1965 Fluid Power Problems

Hydraulics engineers will have power source and hyper-environment problems to solve in space vehicles of future.

Based on a report by

Sorro Prete,

Hydraulic and Pneumatic Section, Aircraft Laboratory, Wright Air Development Center, ARDC

WHAT problems will the hydraulics engineer of 1965 face? Number ONE looks like finding the power to drive his equipment. Following close will be the new high-altitude effects plus all the present-day requirements with which he must deal.

Present trends indicate growing emphasis on space vehicles and boost-glide type aircraft. During the major portion of such flights, the primary source of power is not operating. Accessory equipment will be driven by auxiliary power and chances are the hydraulics engineer will have to work on the power source. This is a change from the present, where the information of the power shaft, a list of services to be performed, loads, and speeds are supplied and the hydraulics engineer sets out to design a system to do the job.

A realistic appraisal of the present satellite vehicles shows that hydraulics may supplement the present electrical system. In the future, the satellites will grow in size, become more sophisticated, and carry men. When they reach this stage, there will be a need for fluid power to control:

- Altitude.
- Cameras and antennaes.
- Solar radiation collectors.
- Engine gimbaling.
- Flight controls for re-entry vehicles.
- Landing devices.

The use of hydraulic power for these and other devices depends on the development of a reliable, light-weight, long-life power unit to drive the hydraulic pumps. Unless the hydraulics engineer attempts to integrate the source and utilization of power, costly development delays may result.

Designing for Hyper-Environments

Investigation of altitudes above 75,000 ft has produced preliminary results of interest to the fluid power engineer. Some results are:

High-Altitude Pressure — The atmospheric pressure at extremely high altitude begins to approach a vacuum at 10^6 ft (200 mile), where it has been calculated that the pressure is 2.58×10^{-10} psi. At an altitude of 95 miles the coefficient of friction between metals appeared to change drastically. In one experiment adhesion appeared to take place and some damage to the surface was noted when the specimens were separated. A basic investigation of this phenomenon is being conducted by the Litton Industries, Beverly Hills, Calif. This drastic change in friction may have an adverse effect on such items as external dynamic seals, bearing, and cylinder rods. At extremely high altitude corona discharge or arc-over may have an effect on electrically operated valves and will require certain design considerations.

Solar Radiation — It is anticipated that solar radiation will not present a serious problem to the fluid power system. However, consideration for direct conversion of this energy may be in order from a fluid power standpoint.

Ozone — It appears that the maximum ozone concentration will occur at approximately 100,000 ft and should be given serious design considerations when operating at altitudes between 80,000 to 120,000 ft.

Dissociated Gases — Between 280,000 and 330,000 ft (50 and 60 miles) a transition occurs in the composition of the atmosphere, with oxygen reported to be 100% O_2 at 280,000 ft and nearly 100% atomic O at 330,000 ft. This may be a problem inasmuch as it will react with materials.

Auroras — X-rays from the auroras may penetrate thin-skinned satellite vehicles and may require consideration in the design of components. Vehicles operating below 10^6 ft (200 miles) would encounter the dense part of the auroras when passing over the poles.

Temperature — The present development goal from a temperature standpoint is 1200 F, which represents the maximum temperature (without cooling) anticipated due to aerodynamic heating and internally generated heat. Fluid power systems operating out of the atmosphere will probably not encounter temperatures this high, although careful consideration of dissipating internally generated heat by radiation under low vac-

Mr. Prete's report was presented to Committee A-6, Aircraft and Missile Hydraulic and Pneumatic Systems and Equipment. It represents one aspect of SAE's Cooperative Engineering Program

1965 Fluid Power . . .

. . . . continued

uum conditions will be required.

Acceleration — Above 300,000 ft altitude, high values of acceleration are not anticipated and should not pose any problem to the component designer. Between 75,000 and 300,000 ft acceleration forces are expected to be less than 10*g*. For the boost glide flight regime during re-entry deceleration of 8*g* over a period of one minute may be encountered.

Vibration — For design purposes, vibrations in the order of the maximum value of 40*g* covering a frequency range of 5–2000 cps should be considered. This vibration will be for short durations which last on the order of 10 sec. Above 75,000 ft (15 miles) altitude the value should be much lower with probably a maximum of 7*g* over the same frequency range.

News Briefs of SAE-ASTM Automotive Rubber Group

THE following result from a fall meeting of the SAE-ASTM Technical Committee on Automotive Rubber.

Completion of Expanded Tabular System Expected January 1959 — January 1 is the target date for completion of the proposed expanded tabular system for a master rubber specification. The proposal combines existing SAE 10R and ASTM D-735 tables into a single specification which is to consist of two tables: One of all current basic tables, and the other of all current suffix tables.

The new system which is being coordinated with the Defense Department's rubber specification program offers a more flexible way to incorporate new polymers and polymer blends.

Upon completion of the proposed table, an effort will be made to fit both solid and cellular rubber compositions into the new system.

Fluid Aging — The validity of ASTM Method D-471 (Changes in Properties of Rubber and Rubber-Like Materials in Liquids) has been re-established. Members blame improper application of this method for the reported discrepancies in test results.

Plans are being made to immerse Viton A and various polyacrylate compounds in five gear lubricants for 70 hr at 300 F. Results of this and other time/temperature immersion studies will be reported at the TCAR's December meeting.

Compression Set — The practicality of shortening the current test time from 70 hr to 22 hr is under final ballot. The new compression set test time will apply to Classes SB and SC for both basic and suffix B requirements.

TCAR work has revealed that the 22-hr-at-212-F test gives compression set results that are approximately 2/3 of the values given by the present 70-hr test.

Here 'N There — Round-robin testing of approximately 12 rubber compounds is under way to determine the adhesive qualities of vulcanized rubber to metal . . . Tear tests are being conducted on mats made to SAE 705 staining, SAE 705 nonstaining, and SAE 709. Conditioning will be for 6 hr at 158 F. The mats will be tested with and across grain . . . An ozone exposure test procedure is being finalized since nine laboratories reported substantial agreement on tests of two neoprene compounds exposed for 24, 48, and 72 hr at 100 F. . . . Neoprene latex film tables have been established. Eventually, they will be expanded to include natural rubber and nitrile latex films.

Roper Joins Traffic Law Group as SAE Rep

LIGHTING Committee Chairman V. J. Roper will represent SAE on the National Committee on Uniform Traffic Laws and Ordinances. His alterate is Howard Mead.

Mr. Roper, who is manager of Product Planning, Miniature Lamp Department, General Electric Co., succeeds Ernest P. Lamb.

Mr. Mead is chairman of the Lighting Committee's Lamp Subcommittee and is chief engineer at the Guide Lamp Division, General Motors.

Truck Cab/Body Measuring System to Aid Designers

A UNIFORM truck cab and body measuring procedure is being developed by the Truck Body Subgroup of the Automotive Body Drafting Subcommittee. Based on a simple letter/number code, it is expected to aid designers of trucks, roads, and garages, as well as statisticians.

The system corresponds to the proposed Car and Body Measuring Procedure now being considered by the Automotive Drafting Committee, according to C. F. Ashley, chairman of the Truck Body Sub-Group.

The following letter/number code will apply to both documents: L, W, and H, will indicate length, width, and height, respectively. A 100 number series will apply to passenger car dimensions, a 200 series to station wagons, and a 300 series to trucks.

Upon Technical Board approval, the truck *and* car measuring procedures will be included in the Joint Aero-Auto Drafting Manual.

Photometric Candlepower Spec Revisions Coming

REVISIONS in the photometric candlepower requirements for stop lamps, turn signals, and school bus and emergency vehicle warning lamps are being considered by the SAE Lighting Committee. Also under consideration is an addition to the SAE Standard on Turn Signal Units which would read:

"The optical axis (filament center) of a Class B front turn signal lamp shall be at least 4 inches from the inside diameter of the retaining ring of the headlamp unit providing the lower beam."

The above are recommendations of the Lamp Subcommittee. The Bulb Subcommittee is working on current ratings for lamps associated with flashes. Detail changes in specifications for certain miniature bulbs are also being studied.

(Note: The separate printing of the Lighting Standards contained in the 1959 SAE Handbook will not be available until March due to contemplated revisions.)

Aero Committee No Longer 'Earth-Bound'

THE Society's growing interest in vehicles which travel through space is reflected in the recent name change of the Aeronautics Committee to the SAE Aero-Space Committee.

An extension of technical committee work to vehicles which travel in zones where the earth's atmosphere no longer affects propulsion lies behind the change, according to C. E. Mines, chairman of the Aero-Space Committee.

In the past, the group's prime interest has been in self-propelled air vehicles.

ARS Pledges Support to SAE

Last spring at a Board of Directors meeting, the American Rocket Society indicated that it would cooperate with SAE's Cooperative Engineering Program. To implement this cooperation, Carson Hawk, Aero-Jet General Corp., was appointed by the ARS to link their work more closely to that of SAE technical committees.

Hot Fuel Handling Trouble Object of Broad Survey

RESULTS of a nationwide survey of hot fuel handling problems as they occurred in actual service are reported in CRC Report 328.

The document tabulates and summarizes the data of a cooperative survey. In addition, it presents comments that might be helpful in evaluating the over-all problem. No conclusions are drawn regarding the significance of the results.

Incidence of the various hot fuel handling problems is shown to vary over a wide range, depending on the conditions prevailing at a particular trouble spot.

At one location on a mid-continent high-speed turnpike, considerably higher temperatures (105–110 F) were encountered and more difficulty reported than at any other location.

At other locations, the incidence rates were well below these levels. In some areas, no trouble of any kind was observed at temperatures up to 95–100 F.

To Order CRC-328 . . . on which this article is based, see p. 6.

News of SAE Parts and Fittings

Roy P. Trowbridge

THE growing popularity of cone-type (Belleville) washers among automobile body engineers has led SAE's Parts and Fittings Committee to create a new group to study standardization possibilities. One reason for the increased use of the cone washer stems from the fact that its reactive pressure, unlike spring-type washers, can be controlled. In addition, it is used extensively where large clearance or adjustment holes are required.

The seventeen engineers who attended the first Washer Subcommittee meeting last fall in Detroit arrived at the following conclusion: Installation torque should result in the tension in the screw or bolt being equal to approximately 50% of the bolt's ultimate tensile strength. This was decided after the group agreed that it was not possible to standardize installation torque values.

Both separate and assembled washers are being studied, according to Subcommittee Chairman George DeLoof, Fisher Body Division, GMC. Of these, only the smooth-edged, low-crown variety which accommodate screws for a No. 6 through a ½ in. size will be considered at this time. Eventually, work on 9/16, ⅝ and ¾ in. sizes may be undertaken.

Involute Splines and Serrations

Roy P. Trowbridge, Chairman of the Parts and Fittings Committee and GMC's Director of Engineering Standards recently reported that the advantages of the extensively revised Involute Splines, Serrations, and Inspection Standard will be the topic of one entire session at Annual Meeting in January. To promote wider and better understanding of this standard, three papers will be presented. They will cover design, gaging, tooling and manufacturing.

It is expected that the revised report (which is a joint SAE-ASA project) will be completed for inclusion in the 1960 SAE Handbook.

In addition to its involute splines and serrations work, the Parts and Fittings Committee is organizing two subcommittees to review the Ball Joint Standard and the Ball Studs and Tie-Rod Sockets Standard, respectively.

Technishorts . . .

IDENTIFYING THE COEFFICIENT OF FRICTION OF BRAKE LINING MATERIALS has long been a problem to fleet operators and maintenance shops. As a result, SAE's Brake Committee will undertake an Automobile Manufacturers Association request to develop a standard system of symbols or color coding to identify the coefficient of friction of brake lining materials. Initiation of work on this project was recently approved by the SAE Technical Board.

TACHOMETER INSTRUMENTS — A design guide for tachometer instruments used primarily in turbine-engined civil transports has been approved by the Technical Board. It will be made available in the near future as SAE Aeronautical Recommended Practice No. 432.

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You can do things with Stackpole Ceramagnet you can't do with conventional permanent magnets . . . and you can handle many ordinary magnet applications better . . . often at less cost. Ceramic magnets have highest magnetic permanency. No keepers needed. They are electrically nonconductive, weigh less . . . and offer numerous other application advantages.

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USED IN:

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WRITE FOR ENGINEERING BULLETIN RC-11A

STACKPOLE CARBON COMPANY

St. Marys, Pa.

STACKPOLE *Ceramagnet*®

THE PERMANENT MAGNETS THAT ARE REALLY PERMANENT

Obituaries

continued from page 98

RAYMOND A. SCHAKEL . . . (M'38) . . . manager of sales engineering division of Diamond Chain Co., Inc. . . . was past chairman of SAE Indiana Section . . . died August 30 . . . born 1900.

WALTER E. LYON . . . (M'41) . . . director of tire engineering and development of Firestone Tire and Rubber Co. . . . has served as SAE Cleveland Section's vice-chairman for Akron-Canton . . . died October 4 . . . born 1903.

BENJAMIN H. BLAIR . . . (M'17) . . . retired as chief engineer, leaf springs, of Easton Mfg. Co. . . . died September 13 . . . born 1888.

NORTON NICHOLS . . . (M'53) . . . sales engineer of Walmil Co. . . . died June 24 . . . born 1913.

JOSEPH F. HORLE . . . (M'31) . . . director of Motor Services Ltd., London . . . died September 17 . . . born 1889.

WINFIELD S. BRINK . . . (M'30) . . . retired as development manager of Firestone Steel Products Co. . . . died September 19 . . . born 1894.

ALBERT BEAUCHAMP . . . (M'47) . . . senior product design checker of Fisher Body Division, General Motors Corp. . . . died September 14 . . . born 1899.

HAROLD P. HENNING . . . (M'53) . . . manager of engineering operations and inspection, General Motors Corp. . . . died September 12 . . . born 1901.

A. F. NOTLEY . . . (M'47) . . . aviation safety advisor, Civil Aeronautics Administration, San Francisco . . . died August 26 . . . born 1894.

GEORGE D. SHAEFFER . . . (M'42) . . . retired as vice-president, director of engineering of Gar Wood Industries, Inc. . . . died September 21 . . . born 1896.

ODBERT P. WILSON . . . (A'14) . . . retired as president of Norma-Hoffmann Bearings Corp. . . . died September 21 . . . born 1883.

STANLEY H. FRANKLIN . . . (M'56) . . . director of research of Fram Corp. . . . died June 16 . . . born 1897.

JOSEPH E. NEUDECK . . . (A'27) . . . senior engineer of Esso Research and Engineering Co. . . . died September 30 . . . born 1896.

CLARENCE G. WOOD . . . (M'17) . . . executive director of Cleveland Senior Council . . . was formerly chief Procurement, Production and Technical Assistance Division of U. S. Small Business Administration . . . died July 19 . . . born 1887.

Heavy duty Kenworth "803" end dump truck has high-strength front axle cast in Nickel alloy steel. Loaded weight—70 tons. Made by Kenworth Motor Truck Company, Seattle, Washington.

All brawn...no deadweight... when truck parts are cast nickel steel

Where you need stamina in cast steel parts – without a dead-weight penalty—you'll do well to look into cast Nickel alloy steel.

Kenworth engineers needed off-road toughness and strength in the front axle of their 36-ton capacity ore truck. Needed light weight, too. They chose a cast Nickel alloy steel containing 1% Nickel, 0.6% chromium, 0.5% molybdenum.

Axle is through-hardened for long life, minimum maintenance.

The finished axle, hardened to 200 Brinell, develops a yield strength of 78,000 psi, a tensile strength of 98,000 psi at 21% elongation.

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Interiors—tailored and tough

Ride—Torsion-Aire terrific

Engines—choice of three

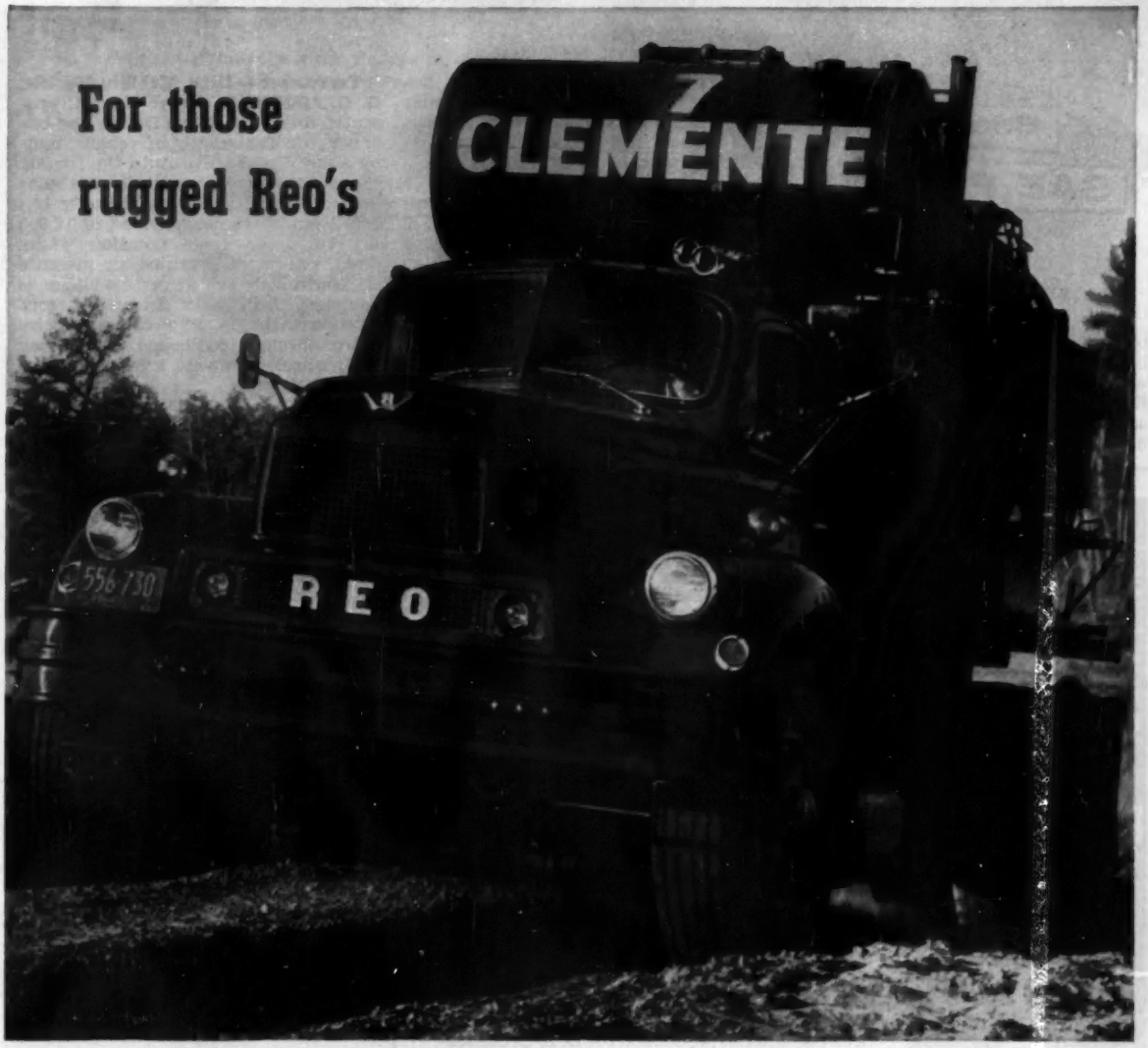
Performance—spirited

Capacity—nothing bigger

Rating—best of show

PUPS OR PEOPLE—there's plenty of extra room in a De Soto wagon. No other wagon gives you more. Full 95 cu. foot capacity. Room for camping equipment, or do-it-yourself hauling. Rear-facing Explorer seat gives back-row passengers full headroom, leg room and a wide rear view (kids love it!).

The smart way to go places...DE SOTO



Reo recommends Sealed Power KromeX piston ring sets with chrome-cyclan top rings

Reo dealers everywhere can now provide famous Sealed Power KromeX Piston Rings for replacement service. These outstanding KromeX Piston Ring Sets are especially designed, tested and approved to meet the rugged performance requirements of the *world's toughest trucks.*

The cyclan-plus-chrome combination in these rings positively defeats excessive heat, side-wear, breakage, friction and corrosion in applications where other rings fail. They break in fast—last, and last, and last.

Sealed Power Piston Rings are original equipment in Reo trucks.

SEALED POWER CORPORATION, MUSKEGON, MICHIGAN

Sealed Power KromeX Ring Sets

Briefs of SAE PAPERS

Continued from page 6

basic power plant trends are established as follows: continuous improvements in engine efficiency, durability, life and dependability, lower weight, and higher specific output; new types or different forms of compounding such as free piston or straight gas turbine are investigated; basic economics will govern engine choice in future, and turbo diesel engine will retain its present competitive advantage.

Problems in Matching Turbochargers to High Speed Diesel Engines, W. E. PARKER. Paper No. 71C presented Aug. 1958, 15 p. Design and function of turbocharger; allowable ratio of naturally aspirated to turbocharged power depends on mechanical limitations of engine, allowable peak firing pressures and type of combustion chamber; best performance depends on component efficiencies being high at same time or same engine operating point; effects of engine usage.

Teracruzer — High Mobility Vehicle, G. D. SIMONDS. Paper No. 73C presented Aug. 1958, 21 p. Design and operating characteristics of vehicle, built by Four Wheel Drive Auto Co. for Air Force as ground support for Matador guided missile, which weighs only 16,000 lb and has max payload of 16,000 lb; Goodyear high flotation 42-in. diam. tires used in which air pressure is controlled by driver; vehicle is equipped with axle drive on front bogie with angle drive bringing drive down through centerline to steering fifth wheel; complete assembly information given.

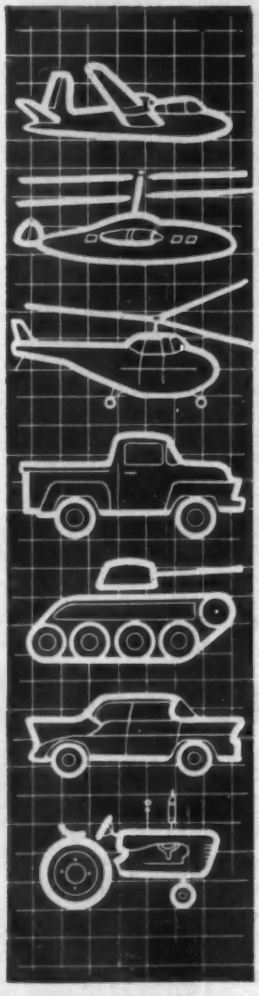
Turbocharged Diesel Engines at Work, W. J. LUX. Paper No. 75A presented Sept. 1958, 16 p. Basic relationships of energy and time involved in engine application problems; turbocharged engine in environment of several typical jobs: vehicle application such as wheel type tractors with wagons or scrapers; shovel and compressor operation; constant load and speed operation; marine and railroad applications, etc; advantages of turbocharged engine.

Futurarmy Engineer Construction Equipment, T. G. TIMBERLAKE, R. G. ALEXANDER, N. P. OGLESBY, W. H. LEATHERS, Jr. Paper No. 75B presented Sept. 1958, 15 p. Program of U. S. Army Engineer Research aimed to develop military specials having multipurpose capabilities and air transportable construction equipment in assault operations; resultant work includes ballastable concept to overcome limitations of aircraft in airborne operations; rubber tired ballastable all purpose tractor, and all purpose ballastable crawler.

Dry Clutch Torque Evaluations, J. R. PROSEK, H. M. BARBER. Paper No. 76A presented Sept. 1958, 8 p. Laboratory study made to provide data for tractor clutch applications and means of screening friction materials; test phases and results include information on relative behavior of ceramic, bimetallic, and organic friction materials in engine clutch applications, peak torque values obtained during clutch engagement, and laboratory test procedure approximating field conditions.

Engagement Characteristic of Wet Type Clutches, L. P. LUDWIG. Paper No. 76B presented Sept. 1958, 21 p. Mathematical analysis of clutch engagement under certain idealized conditions and related experimental work, presented by Twin Disc Clutch Co.; analysis divided into several cases, not necessarily drawn from practical applications; "wear in" process which occurs in some clutch materials, such as phosphor bronze mated to steel plates; effect of grooving; friction of rolled

Continued on page 108



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Fuel Injection Systems in Full Production for Gasoline Engines

After several years of rigorous tests under extreme conditions of weather and environment, the Simmonds SU Fuel Injection System has been put into full production for U. S. Ordnance engines.

The System is being adapted to engines in all horsepower ranges for use in passenger cars, trucks, buses, marine and farm equipment, earth and snow moving equipment.

The Simmonds SU Fuel Injection System is a multiple point, low-pressure, timed speed-density injection system offering these definite advantages: it overcomes major icing problems; it improves cold starts; it eliminates the need of hot-spots and pre-heaters with a resulting increase in power output; it compensates for variations in barometric pressure, altitude and intake air temperature. The System also provides improved fuel distribution resulting in better cylinder head cooling — its operation is unaffected by engine attitude.

Detailed information on SU Fuel Injection Systems is now available. Write on your company letterhead for literature.

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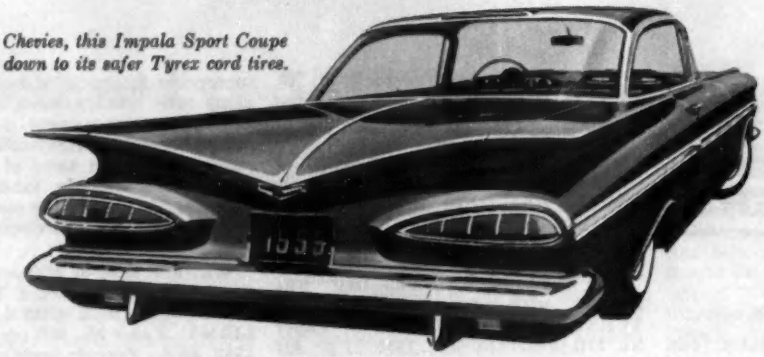
Like all '59 Chevies, this Impala Sport Coupe is new right down to its safer Tyrex cord tires.



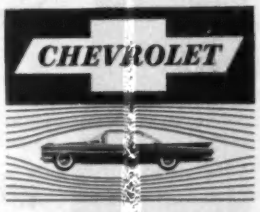
FRESH, FINE AND FASHIONABLE!

Chevy's Slimline design says new in a way all its own. And beneath the beauty there's new engineering that goes down deep. Here's all the car anyone could ask for!

From the clean thrust of its grille to the jaunty flare of its rear deck, this '59 Chevrolet is shaped to the new American taste. And you'll find its beauty has a practical slant too—with more seating room, new areas of visibility and a longer lasting Magic-Mirror acrylic finish.

Chevy's new engineering goes even deeper. Bigger brakes, improved suspensions, a new super-saving Hi-Thrift 6. Your Chevrolet dealer's waiting now with the car that's definitely new . . . decidedly different. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

'59 CHEVROLET



What America wants, America gets in a Chevy!

The Bel Air 2-Door Sedan—Fisher Body beauty and Safety Plate Glass all around.

Briefs of SAE PAPERS

Continued from page 106

phosphor bronze is 30% greater than sintered bronze.

IHC's New Farm Tractors, W. W. HENNING. Paper No. 81B presented Sept. 1958, 7 p. Features of new line of tractors of International Harvester Co., providing seven basic power sizes, 12-v electrical system, hydraulic power steering, etc.; range of gasoline and diesel engines; elements installed on various tractors.

Now — Practical "Double-Dry" Filtration with Donaclone, H. M. TURNER, D. K. ANDERSON. Paper No. 77D presented Sept. 1958, 11 p. Air cleaner, developed by Donaldson Co., incorporating specially designed Donaclone tube; maintenance of three sections of cleaner, namely, dust cup, tube section, and filter element service; field and performance tests of farm tractors, trucks, military tanks, etc.; rectangular Donaclone developed to meet special military requirements.

Why and How of Military Testing of Cranes and Excavators, A. J. RUTHERFORD, J. W. HOESCHEN, S. F. WILLIAMS. Paper No. 80B presented Sept. 1958, 36 p. Specific tests and methods used in mobility measurements; tests required to protect equipment in transit from damage; determination of capacity, productivity, capability, and problems of testing in establishing method of tabulating and interpreting data; determination of structural competence by means of nondestructive and destructive approach.

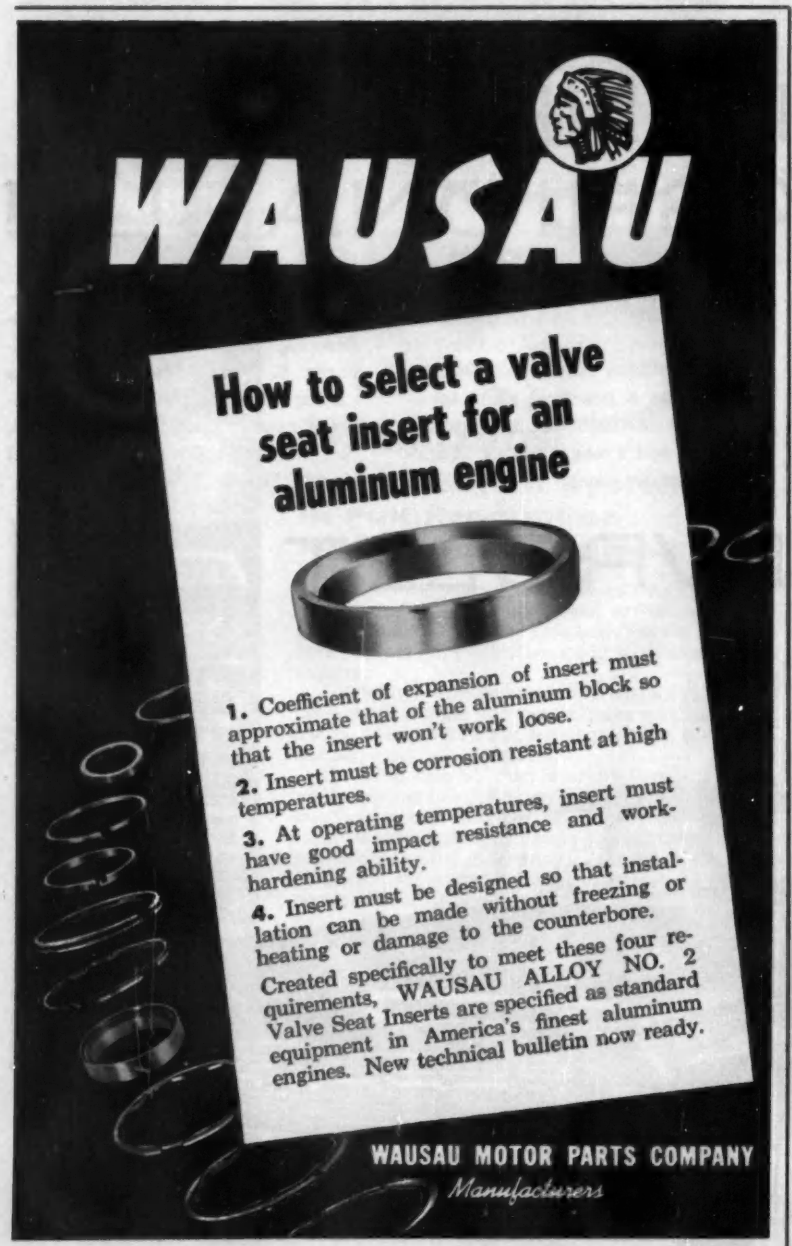
Use of Computers in Design of Construction Machinery, J. B. PEYROT, H. G. KNUDSEN, L. M. RICHARDS. Paper No. 80A presented Sept. 1958, 18 p. Advantages of computer in search for optimum design, particularly in stress determination and stability curves; factors in design of latticed booms of excavating machinery, ranging from ⅜ to plus or minus 5 cu yd bucket capacity, used for dragline, crane works, etc.; determination of maximum boom payloads; testing of booms.

Developments in Forage Harvesting, M. E. McCLELLAN, C. L. CALLUM. Paper No. 79B presented Sept. 1958, 17 p. Machines and tools used from earliest times up to present and future developments; typical forage harvester; advantages of new flail type chopper capable of high production with low initial and maintenance cost; problems in harvesting dry hay; hay bailers and design of objectives involved; successful hay pelleting machine must have output of 5 tons per hr or 175 lb per min.

MATERIALS

Use of Plastics at High Temperatures, I. J. GRUNTFEST. Paper No. 82A presented Sept.–Oct. 1958. 8 p. Usefulness of organic plastics for skins of hypersonic vehicles and efforts made to understand interaction of very hot gases with various materials; specialized aspects of behavior of plastics at high temperatures are shown with respect to values of enthalpy as function of temperature for argon, carbon dioxide and water; chemical considerations; melting point of material.

These digests are provided by Engineering Index, which abstracts and classifies material from SAE and 1200 other technical magazines, society transactions, government bulletins, research reports, and the like, throughout the world.


WAUSAU
How to select a valve seat insert for an aluminum engine
1. Coefficient of expansion of insert must approximate that of the aluminum block so that the insert won't work loose.
2. Insert must be corrosion resistant at high temperatures.
3. At operating temperatures, insert must have good impact resistance and work-hardening ability.
4. Insert must be designed so that installation can be made without freezing or heating or damage to the counterbore.
Created specifically to meet these four requirements, WAUSAU ALLOY NO. 2 Valve Seat Inserts are specified as standard equipment in America's finest aluminum engines. New technical bulletin now ready.
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Many Flops Preceded Automatic Transmission

Based on talk by

CHARLES A. CHAYNE
General Motors Corp.

(Presented before SAE Mid-Michigan Section)

SINCE the birth of the industry, engineers have searched constantly for a transmission suitable to overcome the undesirable characteristics of the internal combustion engine. The Owen-Magnetic electrical drive and the Cartercar friction drive were early attempts at a solution.

The friction drive was re-investigated extensively by GM just prior to development of the Hydra-Matic. Its basic concept was to provide an infinitely variable transmission by varying the angle of a roller assembly between two torus races. Rotating the roller assemblies on their pivot axis in one direction between the races provided an infinite number of underdrive speed ratios. Rotating them in the other direction provided an infinite number of overdrive ratios.

Over 400,000 miles of testing were given to the more than 30 experimental units, but the problems of metallurgy and friction could not be licked and the project was dropped. However, some good did derive from all the engineering effort. The I.V. transmission, as it was called, did establish the basic requirements for the automatic transmission to meet in the designs of the future.

Turbocharger Lifts Diesel-Engine Power

Based on talk by

WILLIAM D. BLIZZARD
Cummins Engine Co

(Presented before SAE Mid-Continent Section)

A LEADING diesel research group has reached six conclusions from a study of turbocharged high-speed, high-output engines. These are:

1. Various types of engine torque curves can be produced by proper combination of the turbocharger air delivery and fuel pump delivery. A rising torque curve of the desired character for vehicle operation is now available.

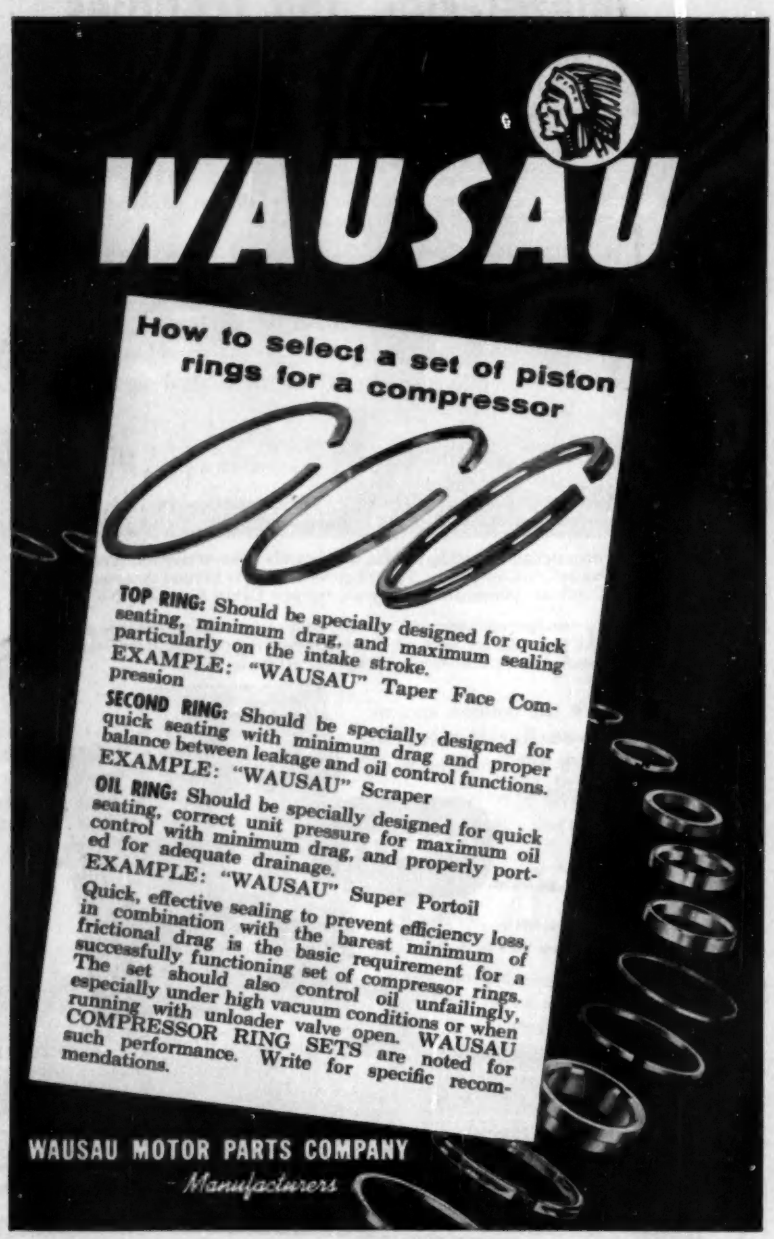
2 Turbocharging has increased the maximum power output of the basic Cummins NH engine to 171 bmep, or 67.5% over the naturally aspirated rating, and fuel consumption has been reduced appreciably as compared with the Roots supercharged engine.

3. Cylinder scavenging can and must be accomplished as high specific outputs are reached in order to keep exhaust temperatures at permissible values. Exhaust manifolding and turbocharger overall efficiency become increasingly important factors in attaining high output.

4. The turbocharged engine can be rated at sea level power up to various altitudes depending on the capability of the turbocharger to compensate for air density loss. High output engines require a high pressure ratio turbocharger with adequate speed capacity for operation without derating.

5. At high specific output sea level power may be maintained at maximum engine speed, but the engine torque curve speed range is reduced with increased altitude operation.

6. Performance while accelerating has been greatly improved by refinements in exhaust manifolding, reduction of turbocharger rotor inertia, and increase in turbocharger overall efficiency.


WAUSAU
How to select a set of piston rings for a compressor
TOP RING: Should be specially designed for quick seating, minimum drag, and maximum sealing particularly on the intake stroke.
EXAMPLE: "WAUSAU" Taper Face Compression
SECOND RING: Should be specially designed for quick seating with minimum drag and proper balance between leakage and oil control functions.
EXAMPLE: "WAUSAU" Scraper
OIL RING: Should be specially designed for quick seating, correct unit pressure for maximum oil control with minimum drag, and properly ported for adequate drainage.
EXAMPLE: "WAUSAU" Super Portoil
Quick, effective sealing to prevent efficiency loss, in combination with the barest minimum of frictional drag is the basic requirement for a successfully functioning set of compressor rings. The set should also control oil unfailingly, especially under high vacuum conditions or when running with unloader valve open. WAUSAU COMPRESSOR RING SETS are noted for such performance. Write for specific recommendations.
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Manufacturers
2600 Eau Claire St., Schofield, Wis. • Detroit Office: 1302 Cadillac Tower, Detroit, Mich.

NEW OAKITE CLEANERS
GIVE YOU MORE FOR YOUR
PAINT-PREPARATION DOLLAR

Here are 4 ways to end pre-paint metal-cleaning troubles

Does your trouble chart show that you need better cleaners, strippers or surface conditioners?

- ☐ Cleaning solution foams excessively in spray washing machine. See 1 below.
- ☐ Streaky discolorations or powdery residues cling to surface of steel parts being stripped for repainting. See 2.
- ☐ Zinc phosphating process too difficult to control... Iron phosphating process doesn't show good results in salt spray tests. See 3.
- ☐ Too many operations—cleaning, pickling, neutralizing, etc.—are needed to prepare steel that does not require phosphating before painting. See 4.

Here are brief descriptions of new Oakite materials designed to end these particular troubles:

1. For a spray washing solution that does not foam at high pressure, try Oakite Composition No. 161. Does not attack aluminum.
2. For stripping pigmented paint, phosphate coatings and undercoat rust *in one operation*, try Oakite Rustripper.
3. For a zinc phosphating process that is truly easy to control, try new Oakite CrysCoat SW . . . For salt spray results far beyond the capacity of ordinary phosphating processes, try new Oakite CrysCoat No. 89.
4. For *one-operation* removal of rust, heat scale, welding residues and light soil together with good preparation for painting, try Oakite Compound No. 131. Inhibited against attack on steel.

FREE Check the coupon and we will send you free booklets or bulletins with full information on new Oakite cleaners.

OAKITE PRODUCTS, INC.
38H Rector Street, New York 6, N. Y.

Send me free booklets or bulletins giving complete information on the new Oakite materials checked below:

- ☐ Oakite Composition No. 161
- ☐ Oakite Rustripper
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- ☐ Oakite Compound No. 131

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COMPANY _____

ADDRESS _____

Superchargers Up Power, Cut Fuel Use In Free-Piston Engines

Excerpts from paper by

H. G. SPIER
Baldwin-Lima-Hamilton Corp.

SUPERCHARGING in the free-piston cycle is definitely attractive as a means of increasing power and reducing part-load fuel consumption. But to get the advantages, the total cycle pressure must be increased. Adequate cooling of the air is necessary for control of temperatures and of power cylinder excess air in the maximum power ranges.

These are among the conclusions to be drawn from a series of analytical studies, backed by actual tests, concerning use of supercharging in the free-piston cycle.

Other important conclusions are:

- In consideration of the history of the diesel engine, the increased cycle pressure ratio concept of gasifier supercharging is realistic. However, in contrast with the case of the diesel engine, a considerable amount of variation can be developed for individual demands.
- A mechanical supercharger drive appears simple, but practically excludes the part-load specific fuel consumption advantage. At least a variable nozzle area main turbine will be required.
- An independent supercharger drive or the use of a turbocharger results in better performance than that obtainable with a mechanical drive. In conjunction with a variable nozzle area main turbine, a turbocharger permits all the performance gains of which supercharged gasifiers are capable. The most practical arrangement appears to be a turbocharger powered in series with the power turbine. This reduces the individual turbine pressure ratios, requires simple ducting, and can reduce cost by the use of standard equipment.
- The general picture of supercharged free-piston gasifier power is highly encouraging. A high specific power-weight ratio of a valve between that of diesel engines and gas turbines is possible without the latter's excessive loss in efficiency over the diesel engine, especially at smaller power ratings.

Basic improvements and simplifications like the combining of scavenging air and bounce air space for what is termed two-stage compression and its effect of lowering valve temperatures, can develop these machines to a degree of competitiveness in cost and performance that is bound to demand commercial recognition.

- The economics of turbocharging of free-piston gasifiers are, of course, all important.

Since a 100% rise in power can be

Continued on page 114

New Swing-Out Swivel Seats invite prospects to discover the newness and greatness of the '59 Dodge, the first all-pushbutton car!

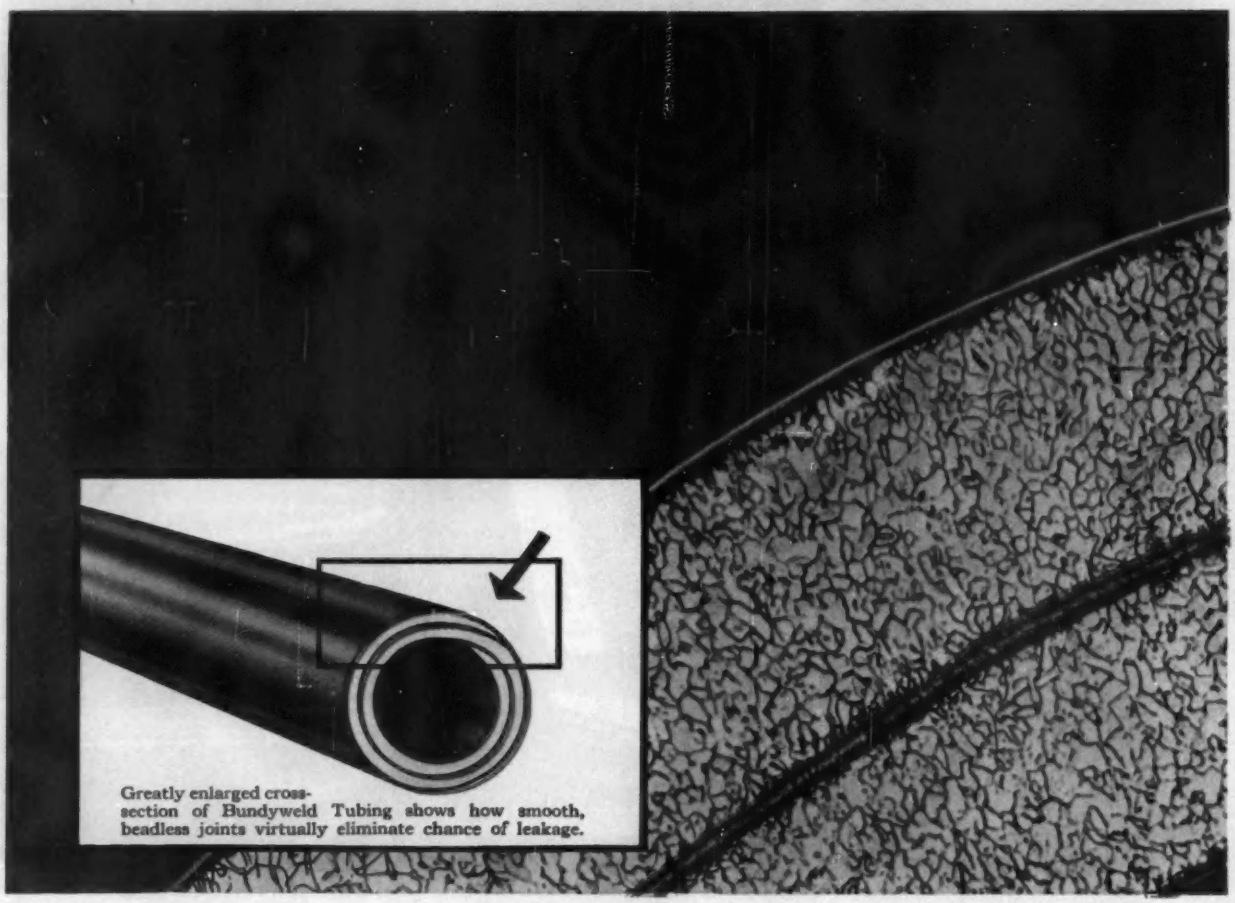
The Newest of Everything Great!

The Greatest of Everything New! Dodge for '59 has everything it takes to put that "I'll take it!" look in a prospect's eye. New Swivel Seats invite him in. New HC-HE engines deliver more thrust, use less gas. New Level-Flite Torsion-Aire smoothes out the road, levels the load. Outside mirrors adjust from the inside. Inside mirrors adjust themselves electronically. Loaded with sell – that's Dodge for '59!

New '59 DODGE

So much that's new! So much that's great! So much that's Dodge!

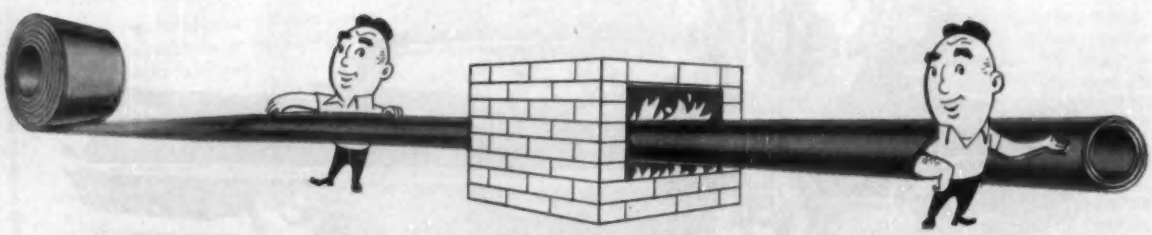
WHY BUNDY LEADS IN MASS-FABRICATION:



Greatly enlarged cross-section of Bundyweld Tubing shows how smooth, beadless joints virtually eliminate chance of leakage.

BEVELED EDGES...Another reason why Bundyweld

And Bundyweld can be mass-fabricated with speed and precision—at minimum unit-cost because of these Bundy advantages:



Bundyweld starts as a single strip of copper-coated steel. Then it's continuously rolled twice around laterally...

into a tube of uniform thickness, and passed through a furnace where copper coating fuses with steel.

Result: Bundyweld Tubing—double-walled, beadless, metallurgically bonded through 360° of wall contact.

is stronger, smoother, easier to fabricate

These Bundy-developed beveled edges provide smooth, beadless joints, inside and out; insure full, double-walled strength however the tubing is cut or bent. They're *one* reason why Bundy leads in mass-fabrication; here are three more:

Bundyweld® Tubing is double-walled from a *single* strip, copper-brazed for high strength and resistance to vibration-fatigue in fluid-transmission *or* mechanical applications. From brakelines to pushrods, Bundyweld is on 95% of today's cars, in an average of 20 uses each.

Bundyweld designers are on call at any stage in the development of your product. They'll help work the kinks out of knotty tubing problems . . . find money-saving shortcuts with no compromise in function.

Bundy fabricators use special Bundy-designed fixtures and machines to mass-fabricate parts to your specifications, at low unit-cost.

Check *first* with Bundy! You'll get the best in small-diameter tubing, *plus* the finest design and fabrication services available. Call, write or wire us today!

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

There's no real substitute for

BUNDYWELD® TUBING

Bundyweld and Bundy specialty tubings are sold through distributors in principal cities

achieved by turbocharging, it follows that this is the thing to do as long as the cost of the turbocharger plus intercooler is less than that of an additional gasifier.

Actually, it is approximately 50% or less of the gasifier cost, while the turbocharged gasifier is approximately 47% lighter than a naturally aspirated machine. In addition, however, the pulse dampening and in many cases the increased load range due to turbocharging, are vital factors in increasing the fields of application and therefore the economic potential.

The ratio of material to labor cost is approximately reversed between U. S. and European manufacturing, the material cost for this type of machine being lower in the U. S. and higher in Europe. This fact can vary the degree of advantage of turbocharging somewhat.

Also, the size of the machines and the availability of suitable production turbochargers is of importance. But since relatively large free-piston gasifiers approach the power ranges of steam turbine and atomic powerplants, the future looks brighter for smaller unit sizes, which at the same time permit easier servicing and greater universality in application, lower cost per horsepower and the typical security in multiple units.

To Order Paper No. 101B . . . on which this article is based, see p. 6.

Depend on EUREKA RADIATORS for RUGGED ENDURANCE & MAXIMUM COOLING

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OVER 30 YEARS OF SPECIALIZATION

For over 30 years, EUREKA Cores and Radiators have served the automotive industry with utmost dependability. Our facilities, equipment, and personnel are available for your needs. We welcome the opportunity of integrating our specialized skills with your needs to help you achieve a well-planned production schedule.

What are your requirements? We can build Radiators to your order in any type, to any size or shape. Send us your blueprints for prompt quotations!

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AUTO RADIATOR Manufacturing Co.

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Why Wait? Reduce Costs Now

Based on secretary's report by

W. A. SCHLINKMANN

Allen Bradley Co.

ALMOST every company in this country can reduce costs at least 10%, if not 15–25%. By and large management puts off acting as long as possible — and this creates trouble. It takes time to get a program started and that's when competitors cut in. Moreover, cost-consciousness cannot be turned on and off at will. Once it deteriorates, it's hard to rebuild.

Effective cost control requires three basic steps:

1. Review department operations and establish intelligent budgets and goals. Keep the basis simple.
2. Investigate each major expense area to determine how economies can be made.
3. Establish targets supervisors will accept, attainable but not loose. Tie them in with your profit objective.

Cost reduction is a continuing process. The moment management relaxes control, costs will start getting out of line. Control and followup are essential.

It is important, too, to apply cost control techniques at the beginning of the design activity. The greatest savings can be made by getting the lowest possible costs at the outset. While constant attention must be given to reducing costs of existing products and operations, it is a mistake to confine efforts to these areas.

Training Personnel

The forward look in training is to develop rather than train. Develop the desire within the individual and tailor the program to the individual rather than the group. For more effective results, the training assignment is being shifted from the training department to the line organization. A more down-to-earth approach will be used and the need will be integrated with the production goals.

Most supervisors are practical people. They don't like theory in training sessions; they like guides they can use and not a lot of procedures: So be

Continued on page 117

Bowling Equipment Manufacturer Switches To Molds Made With

POLYTOOL Epoxy Tooling Compounds

The molds used to form the "Fairlane" bowling alley equipment produced by the M. Blatt Co., Trenton, N. J., formerly chipped and cracked when molded parts were removed. They needed replacement after a single year's service. Now, the same molds are being constructed with RCI POLYTOOL epoxy tooling compounds.

"After six months of heavy usage," says Mr. Louis Tavani, shop foreman, "our first epoxy mold is free of any chipping or cracking. We now expect molds made with the RCI epoxy compound to last at least 5 years!"

These RCI epoxy materials promise any company greater mold durability, which means big savings on production costs. Greater dimensional stability and resistance to shrinkage are other important features you'll find in RCI POLYTOOL epoxy compounds.

The actual finished products derived from these Blatt Company molds (such as the bench shown above) are constructed of RCI POLYLITE polyester resin reinforced with glass cloth. The coloring comes from an RCI gel coat that is applied to the mold first.

The M. Blatt Co. constructed their first epoxy mold with the help of a Reichhold technical representative skilled in the use and performance of POLYTOOL compounds.

Why not write RCI for full details on the profit potential of POLYTOOL epoxy tooling compounds and POLYLITE polyester resins in *your* application?

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

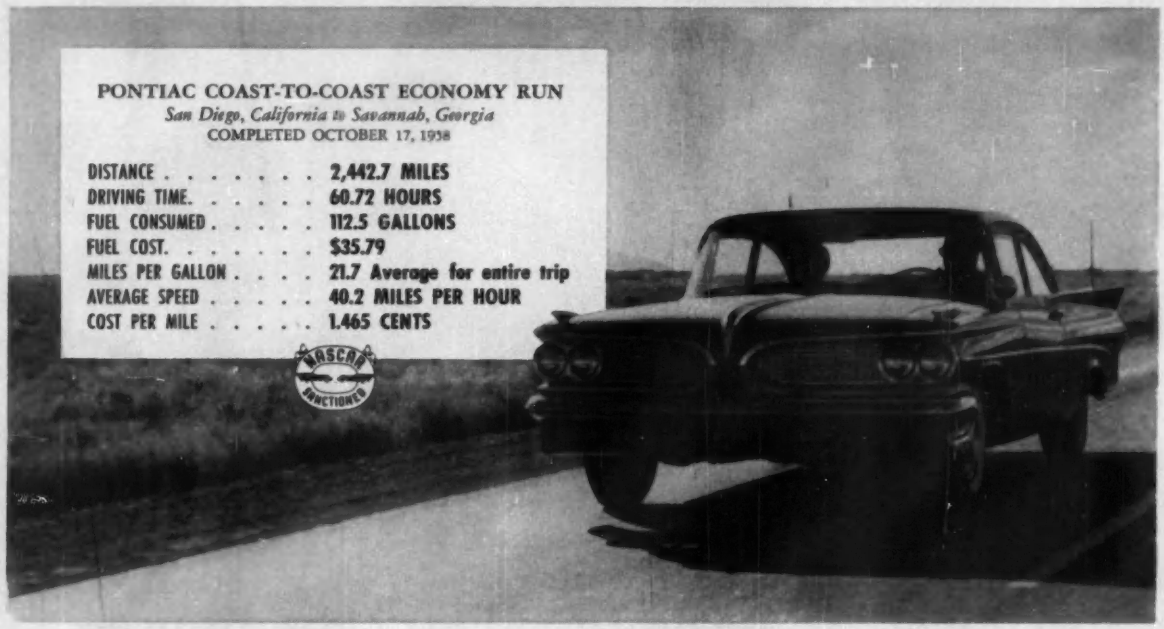
REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.

Creative Chemistry . . . Your Partner in Progress

RCI

COAST TO COAST ONLY 1½ CENTS PER MILE FOR GAS!

Pontiac's new Tempest 420E V-8 sets the year's most important economy mark—Here's the story and what it means to you!


PONTIAC COAST-TO-COAST ECONOMY RUN
San Diego, California to Savannah, Georgia
COMPLETED OCTOBER 17, 1958
DISTANCE . . . . . 2,442.7 MILES
DRIVING TIME. . . . . 60.72 HOURS
FUEL CONSUMED . . . . . 112.5 GALLONS
FUEL COST. $35.79
MILES PER GALLON . . . . 21.7 Average for entire trip
AVERAGE SPEED . . . . . 40.2 MILES PER HOUR
COST PER MILE . . . . . 1.465 CENTS
NASCAR
INSPECTED

We asked one of America's most respected car testers—"Uncle Tom" McCahill—to put a standard Pontiac Catalina Sedan with our new economy V-8 to the test.

And with only one specification—that the run would be exactly like *you* would drive coast to coast yourself—in mountains, in city traffic, across deserts, buying gas wherever the tank ran low.

And here's the phenomenal story in every complete detail—all officially certified by NASCAR, America's top automobile competition authority.

What does it mean to you?

Simply—and very importantly—this: For the first time, you can get deep-chested V-8 pep with better mileage than from many smaller so-called "economy cars" . . . and get it on regular fuel!

If you owned a Pontiac with this new Tempest 420E V-8 you'd be saving up to 5 cents a gallon on regular fuel. This new economy V-8 is optional at no extra cost on any Hydra-Matic Pontiac!

See your Pontiac dealer soon—and discover the newest in V-8 performance and economy!

PONTIAC!

America's Number ① Road Car

3 Totally New Series • Catalina • Star Chief • Bonneville

PONTIAC MOTOR DIVISION • GENERAL MOTORS CORPORATION

THE ONLY CAR WITH **WIDE-TRACK** WHEELS

specific. Supervisors understand why costs must be kept down, so give them the proper climate and opportunity to work at it.

In addition to the panel secretary, others serving on the panel which dedevoped the information in this article were: **R. A. Dimeberg,** Allen Bradley Co., (panel chairman); **Brooks Stevens,** Brooks Stevens Corp.; **E. J. Lewee,** A. O. Smith Corp.; **T. A. Haller,** J. I. Case Co.; and **C. G. Oreutt,** University of Wisconsin.

To Order SP-324 . . .
on which this article is based, see p. 6.

Cooperative Approach Aids A-Power Development

Based on talk by

O. C. KEBERNICK
Atomic Power Department,
Westinghouse Electric Corp.

(Presented before SAE Pittsburgh Section)

THE atom has become accepted as that new source of energy to supplement conventional fuels in supplying the world's growing demands.

There is in this country, at present, no desperate need for atomic power at any cost. Other areas in the world have immediate requirements for nuclear power. Since many of our allies are located in regions of high cost and often scarce conventional power, the United States Government has undertaken to accelerate the "natural pace of nuclear development in this country" in order to assist and strengthen allied foreign economies.

The most immediate commercial application for atomic power in the United States is in electric power production. Therefore, utilities and reactor manufacturers find themselves working together in cooperation with the Government in developing this new energy source. There are certain responsibilities in connection with the cooperative approach to atomic power which are uniquely the manufacturers', some which can be handled unusually well by the utilities and still others which are best taken care of jointly.

Among the responsibilities which the reactor manufacturer can best assume are research and development, application of atomic power to utility requirements and cost reductions leading to production of energy which is competitive with that produced from conventional fuels.

Two of the several responsibilities which utilities assume in the cooperative approach to atomic power are reinforcement and building of their knowledge concerning nuclear power and, second, programming of work in reactors they have sponsored to permit training of people and postconstruction research and development.

In the area of shared responsibility and, in particular, with regard to shared risk, are problems pertaining to warranties and price. In the atomic energy field, yet in the early stages of its development, warranties cannot yet be offered by a manufacturer to match those which a utility receives covering a conventional plant. Similarly, pricing of apparatus must reflect the developmental nature of many designs and the lack of experience with regard to performance of that apparatus.

The cooperative approach to atomic power in great degree involves extension of commercial and engineering relationships that have built up between utilities and equipment manufacturers over the years. This established relationship now has a new dimension added in that Government regulations and support of research and development programs enter into the accelerated effort toward competitive power from the atom.

Get Samples and Data on these cost-cutting Fasteners!

PALNUT FASTENERS
for fast assembly on low-cost
plain unthreaded studs

PALNUT SELF-THREADING NUTS

Form deep, clean threads on unthreaded studs or rod while tightening. Provide vibration-proof grip on studs, whether seated for load-carrying, or unseated as a "stop" nut. Adequate prevailing torque keeps nut in position. Hex form fits all standard tools for easy fast assembly. Washer base spans holes and slots. Also available with sealer washer. May be removed and re-used. Sizes for 1/8", 3/16" and 1/4" dia. rod or studs.

PUSHNUT® FASTENERS

These tempered spring steel fasteners quickly push or tap on unthreaded studs, rod, wire or rivets. Rugged holding power. Very low in cost. Easy and fast to assemble with manual tools, air hammers, arbor presses or jigs. Variety of types and sizes for wide range of applications.

FLAT TYPE H
Provide tight, vibration-proof assembly of ornaments, medallions, nameplates, etc. Grip securely, even on hard chrome studs. Sizes for 1/8", 3/32" and 1/8" dia. studs.

Type C (closed end)

ACORN TYPES
Pleasing appearance and good holding power for fastening or covering ends of rods, studs or rivets. Six sizes from .120" to .312" dia.

Type CK (open end)

CAP TYPE W

Decorative cap fastener of heavy gauge spring steel, has powerful removal resistance on unthreaded rod, studs, rivets, pins and shafts. Sizes for 3/16", 1/4", 5/16" and 7/16" dia.

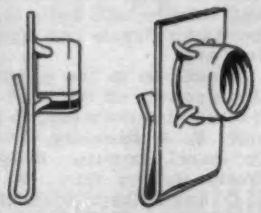
Write for free samples and data, stating type, size and application

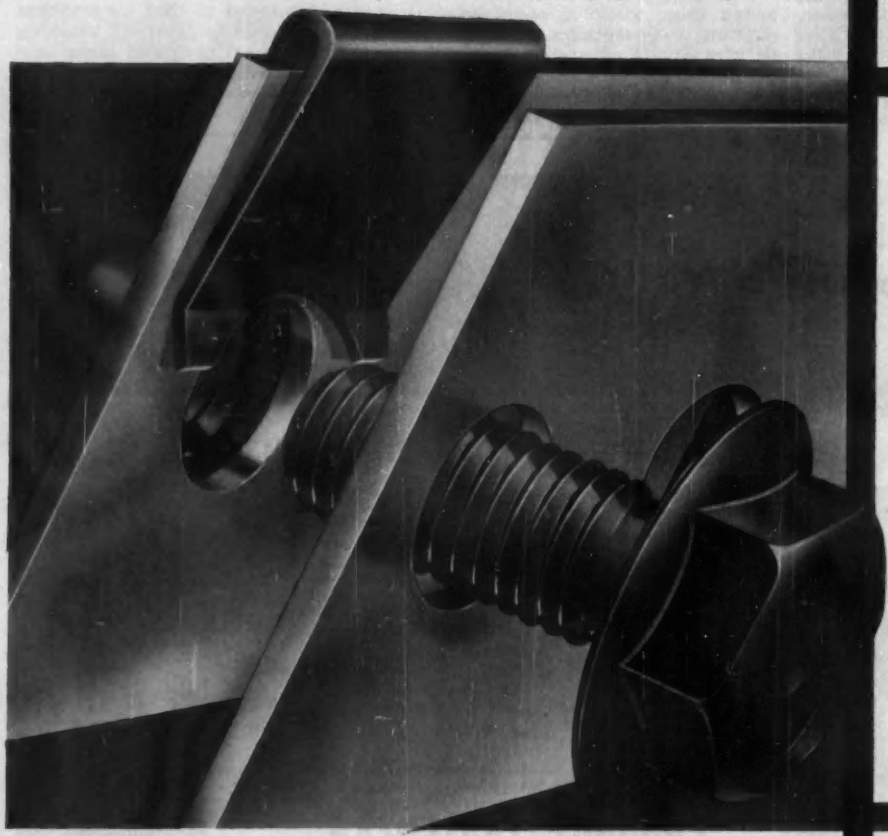
THE PALNUT COMPANY, 70 Glen Road, Mountainside, N. J.
Detroit Office and Warehouse: 730 West Eight Mile Road, Detroit 20, Mich.

PALNUT® LOCK NUTS FASTENERS

Quick, secure fastening at low cost

DOT makes J NUTS with a difference





- FLUSH SEATING
- SELF-RETAINING
- SELF-TENSIONING
- LOW COST
- CAREFUL WORKMANSHIP

It takes a little extra care in the drawing operation to make really reliable J-nuts in volume but it's well worth the trouble. It reduces internal strains in the barrel so that DOT J-nuts stand up to working loads considerably better than the average fastener of similar construction.

Available in three thread sizes (5/16″-18 and 24, 1/4-20) and to fit three ranges of material thickness (.030″ to .065″), DOT J-nuts are made of carbon steel. They hold themselves in place over stamped holes so that preassembly is practical in cases where the actual bolting operation comes at the end of a series of other operations.

Full details on request.

CARR FASTENER COMPANY

Division of United-Carr Fastener Corporation, Cambridge 42, Mass.

MAKERS OF DOT FASTENERS

letters from readers...

From:
E. N. Rahusen
Patent and Consulting Engineer
The Hague, Netherlands

Dear Editor:

I thank the SAE very much for its letter of September 22 signed by its president and for the beautiful certificate of 25 years of active membership.

I avail myself of this opportunity to inform you that the SAE has been the origin of a Dutch society called "Motor Technisch Colloquium." In March, 1936, the Overseas Relations Committee of the SAE wrote to Mr. Boerlage:

> "SAE Vice-Presidents C. Herbert Baxley and Almon L. Beall have suggested the possibility of an informal conference with you at Delft during the visit which our Mr. Veal and Mr. Baxley will make with you early in July.
>
> "In the event that some such informal meeting appeals to you, we would appreciate your cooperation in getting together a group of members and friends to meet with our delegation.
>
> "I understand from Mr. Veal that he and Mr. Baxley will undoubtedly establish contact with you in Paris at which time suitable details can be developed."

The result of this was an informal meeting in July, 1937, and the above-mentioned Motor Technisch Colloquium which was born from that meeting has been flourishing since. There is a meeting every two months and this December the hundredth meeting will be celebrated.

The Motor Technisch Colloquium has been mentioned in the SAE Journal, November, 1945, stating "Dutch SAE members hold meetings despite Nazis."

• ——— •

From:
Engineering Library
Scintilla Division
Bendix Aviation Corp.
Sidney, New York

Dear Editor:

We would like to obtain a copy of the Index of articles published in the 1957 SAE Journal.

We have a complete file of SAE Journals from 1935 to the present date and would appreciate it if our name could be added to your mailing list for all new Indexes published.

(The SAE Journal Index for the calendar year is bound in at the end of the December issue. This was done for the first time in 1957. — Editors)

From:
V. L. Schatz
Manager, Business Systems
General Electric Co.
Cincinnati, Ohio

Dear Editor:

The article entitled, "Needed: Better Ways to Use World's Technical Literature," in the September *SAE Journal* was of particular interest to me. We have just completed and placed into operation a high-speed computer (IBM 704) program for information retrieval in our Technical Library here at the

continued

--a sweet running job

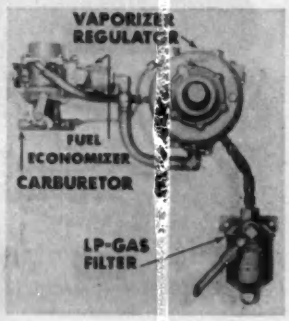
Minneapolis-Moline LP-Gas Powered Tractor Model 445.

--OEM* EQUIPPED WITH ENSIGN

Here again is another fine example of tractor engineering in which top-notch performance on LP-Gas assures the farmer of unprecedented economies in fuel and engine maintenance. We are proud indeed to have our LP-Gas carburetors included as original equipment on Minneapolis-Moline tractors.

As the leading manufacturer of LP-Gas carburetion, we are constantly in search of better methods and materials to give added years of economical engine operation on tractors equipped with Ensign. We have gained valuable experience in this field and are most happy to share it with you. Write us for recommendations on your carburetor needs. Ensign dealers and representatives cover the nation. Insist on Ensign—accept nothing less!

*OEM *means "Original Equipment Manufacturer." It means that the manufacturer of this tractor has chosen Ensign carburetion as standard equipment.*



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1551 E. Orangethorpe, Fullerton, California
Branch Factory: 2330 W. 58th Street, Chicago, Illinois

"THIS LUBRICANT CUT OVERHAULS IN HALF"

—says WESTERN AUTO TRANSPORTS, INC.

"Operating over 200 tractors and 200 trailers from Detroit to the West Coast, we encounter temperatures from 120° above across the desert to 40° below in the mountains of Colorado. We have found that with LUBRIPLATE our wheel bearing packing mileage has tripled. Since using Lubriplate A.P.G.-90 in our transmissions and differentials, we are getting double the mileage between their overhauls."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

letters from readers... continued

Aircraft Gas Turbine Division of General Electric.

This program will perform file updating and up to 99 literature searches simultaneously. The program also provides printed abstracts to the requester.

To date we have successfully accomplished file updating and 85 searches simultaneously. The machine time for this operation was 9 min. About 1500 abstracts were obtained from these searches. These were transferred to tape in about 10 min of machine time.

These indications of machine speed seem to contradict the findings in the second paragraph under "Machine Searching" of your article. I recognize, of course, that there is a wide variety of approaches to information retrieval and that we may not necessarily be comparing like systems.

• ——— •

From:
Mrs. Nancy B. Cozzens
Director of Guidance
Los Altos High School
Los Altos, Calif.

Dear Editor:

We are attempting to contact scientists, mathematicians, and engineers who might be willing to help in the science seminar program we are planning for outstanding students in our high school. This project is under the auspices of the Joe Berg Foundation for the Advancement of Science with which you are undoubtedly familiar.

Can you give us a list of some of your members who live in this area so that we may invite their assistance? The area might include Palo Alto, Atherton, Redwood City, Menlo Park, Mountain View, and Sunnyvale, as well as Los Altos.

Thank you for your help.

(The SAE Roster lists SAE members two ways: alphabetically and by company affiliation. A check through the company listing of companies in this area gave the names and positions of several SAE members who might be helpful. — Editors)

• ——— •

From:
J. J. Freeman
Vitro Laboratories
Division of Vitro Corp. of America
Silver Spring, Md.

Dear Editor:

The current ONR Strato-Lab program aims to make available to academic, industrial, and government scientists a manned, sealed, balloon-borne laboratory 20 to 25 miles above the earth for purposes of research, environmental testing, and systems experimentation.

If this new research tool which is being offered to scientists for their explorations is to have maximum usefulness, each prospective user must have the opportunity to participate in determining its specifications. How a research objective is to be accomplished, what particular instrumentation will be employed, what assumptions are made concerning the platform, will have to be determined for each experiment so that the functional requirements imposed on the basic Strato-Lab vehicle will become more or less evident.

Accordingly, Office of Naval Research has asked Vitro Laboratories to put these questions before the scientific community: Would a manned balloon-borne stratospheric laboratory assist or further your research and development activities? How? What functional requirements, i.e., stability, weight, etc., would these activities impose on the Strato-Lab?

• ——— •

From:
R. M. Oppenheimer
Combustor & Turbine Design Unit
Small Aircraft Engine Department
General Electric C[illegible]
West Lynn, M[illegible]ss.

Dear Editor:

The following is a discussion based on the paper "Control and Measurement of Cleanliness Quality in Turbo Fuel" (SAE Paper No. 69C) by C. E. Loeser, D. D. Love, and A. R. Ogston. (See also an article based on this paper on pp. 55–57, SAE Journal, November, 1958.)

In response to the author's request for information from engine manufacturers, the writer's experience has shown that metallic contamination has a strong effect on thermal stability and gum formation. This contamination may possibly be organic-metallic compounds. We refer to the work of the Navy Aeronautical Engineering Laboratory, Philadelphia, Pa., as to the effect of lead, copper, and copper bearing alloys upon thermal stability. In particular, it was found that circulating fuel at room temperature through copper pipes caused a fuel which tested within specification limits to become degraded to a point far beyond limits.

The effect of poor thermal stability

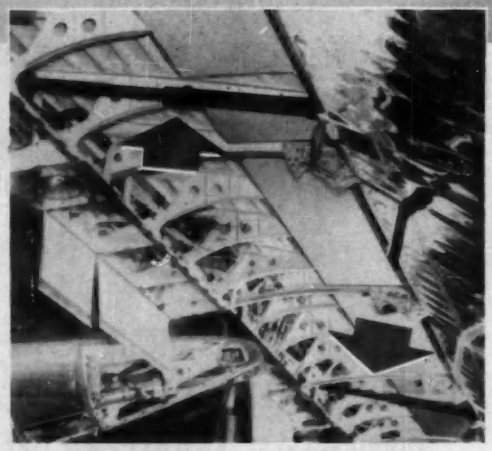
continued

FAR-REACHING EXTENSION FROM LIMITED ACTUATOR SPACE

Now Saginaw supplies the answer to your most difficult actuator space problems with the Multi-Extending Saginaw Screw! Utilizing Saginaw's time-proved *recirculating ball* principle in multiple telescoping sections, the Multi-Extending b/b Screw conquers actuator space obstacles designers have been seeking to overcome for years! Here's why:

1. **UNIT EXTENDS** in a ratio of 2.5 to 1, providing maximum extension 2½ times the length of the retracted screw.
2. **FAR GREATER LOAD CAPACITY** than any other telescoping device in its class.
3. **FAR MORE PRACTICAL AND TROUBLE-FREE** than other telescoping units on the market.
4. **PRECISE, DEPENDABLE POSITIONING** and control within thousandths of an inch.

• OVER 90% EFFICIENCY • REQUIRES UP TO 4/5 LESS TORQUE than acme screws • LESS DRAIN on power supply • CONSERVES SPACE AND WEIGHT • OPERATES DEPENDABLY at extreme temperatures • PERFECT FUNCTIONING with only initial lubrication



USED ON THE COUNTRY'S MOST MODERN AIRCRAFT—Multi-Extending b/b Screw wing flap actuators being installed on the new Lockheed Electra.

The Saginaw Multi-Extending Screw is also used to actuate speed brakes, afterburners, variable air inlets, canopies and similar critical components on today's newest aircraft.

Send today for the new 1959 engineering data book on Saginaw b/b Screws and Splines... or see our section in Sweets Product Design File.

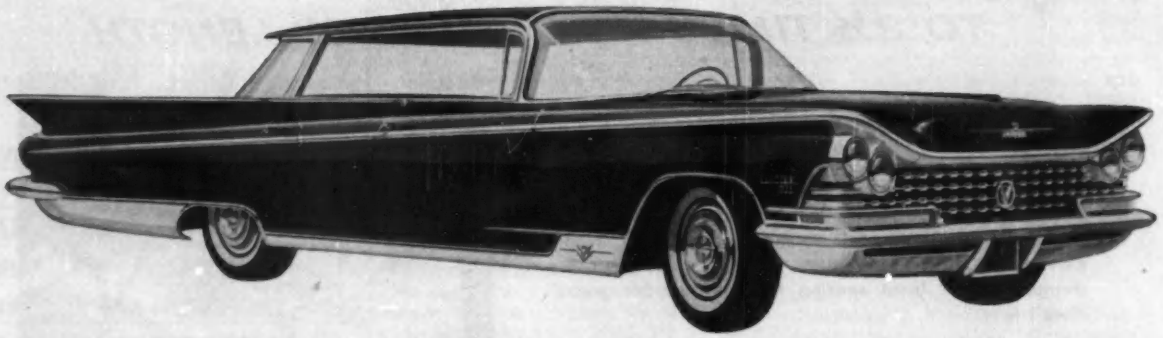
Saginaw

WORLD'S MOST EFFICIENT ACTUATION DEVICE

ball bearing Screw

SAGINAW STEERING GEAR DIVISION, GENERAL MOTORS CORPORATION • SAGINAW, MICHIGAN

AMERICA HAS NEVER SAID "OKAY" SO FAST!



THIS NEW BUICK IS "HOT". PEOPLE ARE ORDERING **THE CAR** AT A RECORD CLIP... ACTUALLY THREE TIMES AS MANY NOW AS AT THIS TIME LAST YEAR. NO DOUBT ABOUT IT... BUICK IS THE CAR FOR 1959. SEE WHY AT YOUR BUICK DEALER SOON!

BUICK MOTOR DIVISION, GENERAL MOTORS CORP.

THE CAR: BUICK '59

LE SABRE *the Thriftiest Buick* **INVICTA** *the most Spirited Buick* **ELECTRA** *the most Luxurious Buick*

A NEW CLASS OF FINE CARS WITHIN REACH OF 2 OUT OF 3 NEW CAR BUYERS

Watch Dale Robertson in Tales of Wells Fargo on NBC-TV Monday Nights

letters from readers... continued

will be varnish and gum formation, especially in those fuel systems which must use the fuel as a heat sink for lube oil cooling. (See SAE Paper No. 47A: "Relation of Fuels to Aircraft Turbine Engines," by E. A. Droegemueller and R. K. Nelson; also, see article based on this paper on pp. 48–49, SAE Journal, June, 1958.) Also, systems in which the fuel manifolds are "buried" in the combustor are particularly sensitive to fuels which are out of specification limits for thermal stability.

Another effect of metallic contamination has been a hard, mostly carbonaceous deposit on the fuel nozzles. This deposit contains a high (up to 15%) metallic content, indicating that control of metallic contamination is highly desirable. Again copper and lead are the chief offenders. The lead often seems to come from litharge which is sometimes mistakenly used as a pipe sealing compound in fuel systems and tank farms. Lead can also be induced through contamination (mixing) with leaded gasoline either in pipe lines or tank cars. The Navy Aeronautical Laboratory recommends either stainless steel or internally coated tanks and piping. There are about a dozen commercial coatings which they have approved for use in shipboard and shore installations. Among these is Saran. The Navy has instituted a program for coating all its non-stainless steel tanks used for jet-type fuel.

It is not possible to specify, at this time, the maximum levels, in parts per million, which can be tolerated. Some fuel refineries control individual concentrations of iron, copper, and lead to within 2 parts/million. However, we cannot urge too strongly that all fuel systems be either stainless steel or be coated with an adequate inert material such as the Navy uses. The use of copper and copper bearing alloys for tanks, piping, filters, screens, fuel pump bushings or rotors or valves will aggravate an insidious and difficult problem.

From:
Charles R. Bell
Sr. Research Engineer
Canoga Park, Calif.

Dear Editor:

I believe that there is no disagreement on the subject of shortcomings in scientific organization of data retrieval, which is now becoming an enormous problem. It is undoubtedly the wide spread of duplication of efforts which is adversely affecting our research and development progress. It should be the aim and obligation of engineering societies to minimize such deficiencies. Among the most obvious items on such subjects are the following:

1. Organize meetings governed by solicited popular inquiries among members. Such meetings should specialize on desired, specific subjects and should provide up-to-date references and guidance by colleagues currently engaged with such given subject. That way an effective mutual support may be provided and faster progress of the "state of art" realized.

2. Attempt to minimize the growing damage to research by the so called

continued

• CASTINGS
"TECHNICAL POLICEMEN"
on patrol
every hour, every heat, every day
If you require meticulous precision in the metallurgical, chemical, and physical properties of your castings, you will find it here.
Customers tell us that our ability to maintain the most complex alloy specifications is so marked that we are often referred to as "the prescription counter foundry."
We specialize in small castings in high volume — alloyed gray and white irons, and high alloy steels. We invite inquiry.
Makers of important component castings for the automotive, aircraft, hydraulic, and special machine industries.
ENGINEERING CASTINGS, INC.
Marshall, Michigan
Licensed Producers of Ni-Hard, Ni-Resist, Ductile Iron, Ductile Ni-Resist
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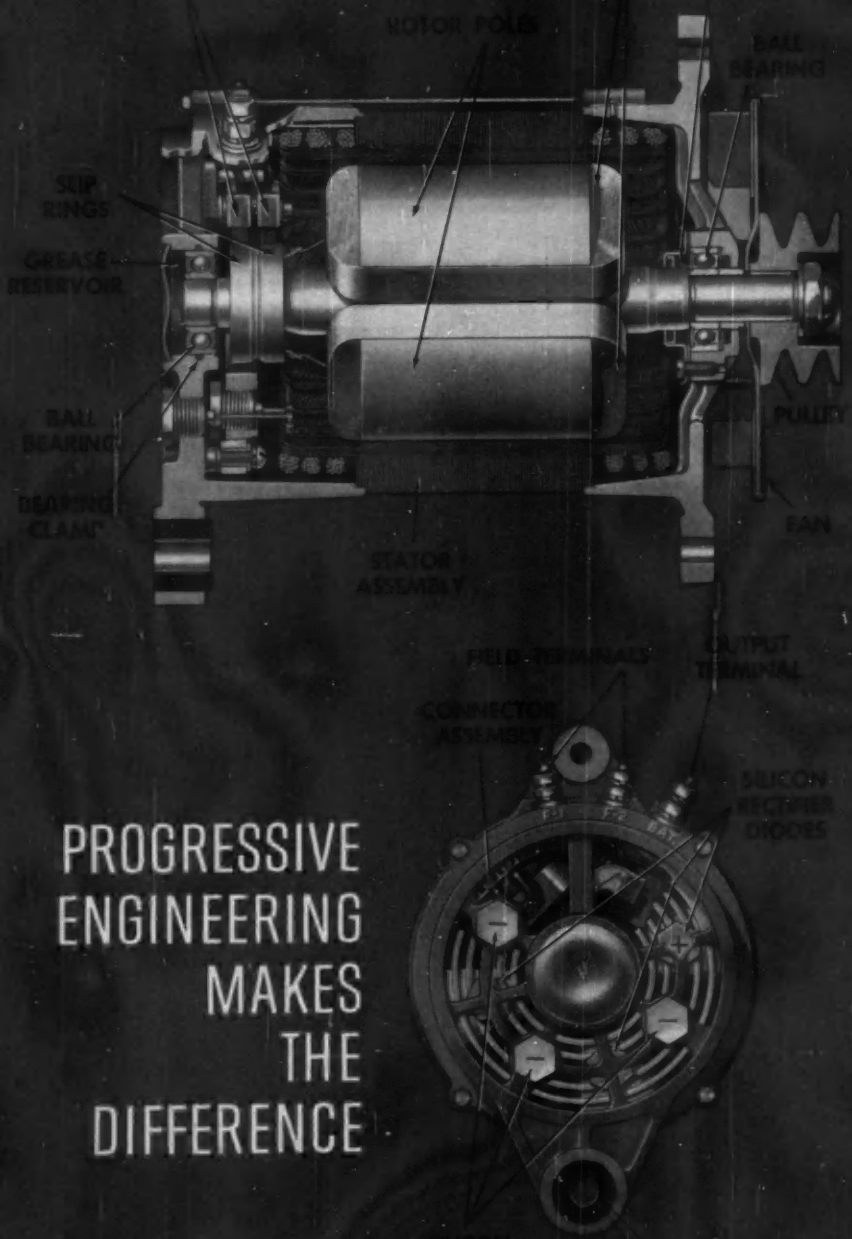
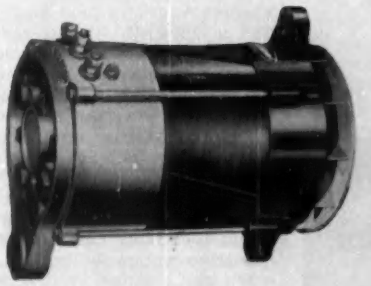
NOW! REAL CHARGE-AT-IDLE,

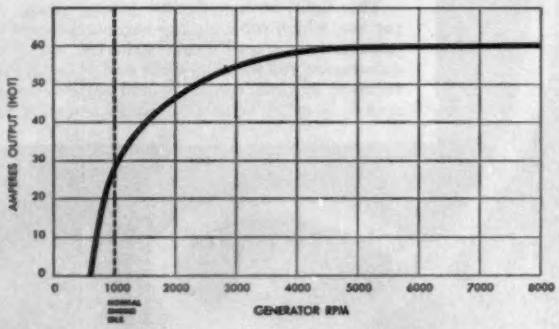


PROGRESSIVE ENGINEERING MAKES THE DIFFERENCE

UP TO TWICE THE TOTAL OUTPUT

WHEN YOU REPLACE STANDARD D.C. EQUIPMENT WITH DELCO-REMY'S NEW SELF-RECTIFYING A.C. GENERATOR





Here's a completely new generator from Delco-Remy *specifically designed* to take care of cars and trucks with extra-heavy electrical loads under all traffic conditions . . . to increase battery life by eliminating deep cycling.

Designed to mount interchangeably with most standard d.c. generators, this compact new unit is only 5¾" in diameter and weighs just 31 pounds. The a.c. design eliminates commutation problems, providing extra-long brush life . . . and the ball bearings are "lifetime" lubricated so that no attention is required between engine overhaul periods. Six specially developed silicon rectifiers built into the end frame eliminate the need for space-consuming external rectifier units, reducing installation time and cost to a minimum.

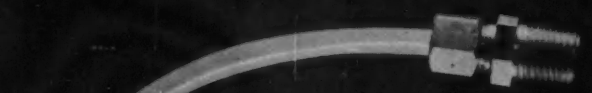
Be sure to specify this new self-rectifying a.c. generator along with its companion transistor regulator (either full or transistorized model) on your new special-duty equipment for 1959. This all-new power team is still another example of Delco-Remy progressive engineering at work for you.

GM GENERAL MOTORS

GENERAL MOTORS LEADS THE WAY—STARTING WITH Delco-Remy ELECTRICAL SYSTEMS

DELCO-REMY • DIVISION OF GENERAL MOTORS • ANDERSON, INDIANA

Original Equipment on the New Air Suspension



Chemiseal® Nylon Pressure Tubing

. . . has provided automotive engineers with a new "tool" for accomplishing a great advance in motorcar riding comfort.

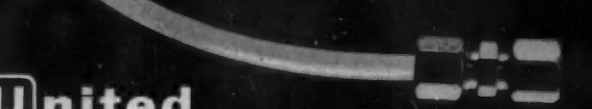
This light, strong, flexible tubing—many feet of it per car, which connects the various components of the pneumatic system—meets stringent performance requirements at a fraction of the cost of metal tubing with required flexible couplings and intermediate fittings. And it is easier to install—saves assembly time.

Outperforms metal at a fraction of the cost

Chemiseal Nylon Pressure Tubing is available in 1000 psi and 2500 psi grades, which conform to J.I.C. specifications for low and medium pressures. Advantages include: high pressure rating at low cost; long flex and vibrational life; resistant to oils, greases, solvents, chemicals; wide service temperature range; crush and abrasion resistant; adaptability to standard metallic fittings. Other feasible automotive applications include: automatic lubrication systems, fuel lines, oil lines, hydraulic systems.

For prompt service, contact one of The Garlock Packing Company's 30 sales offices and warehouses in the U.S. and Canada, or write

United States Gasket Co., Camden 1, N. J.



United States Gasket *Plastics Division of* GARLOCK

letters from readers...

. . . continued

"proprietary interests" which are detrimental to the national defense efforts. There is plenty to do for everyone and "proprietary interests" should remain only in the fields of home appliances and customer items for civilian market.

3. Sponsor scholarships for able engineering and science students stipulating that they have to cooperate on organization of data retrieval (ref: writer's contribution in Aviation Age, June, 1958, issue, "Readers' round table").

The growing volume of theoretical as well as of experimental information in each and every field must be organized intelligently, if this country is to regain leadership in technology.

Last but not least, engineering societies must become interested in political developments. A growing number of scientists and engineers is disturbed by the fact that the results of their work might be used by incompetent political demagogues, lending them uncontrollable powers which would inevitably cast the shadows of collective responsibility. . . . The scientist and engineer cannot continue to hide behind the ideas of blind loyality without participating in national development of political and economic integrity. It is time to look at the people who claim to represent the major portions of American population and analyze whether they are carrying the colors of American Independence, or decadence of the Western world.

From:
F. E. Moskovics
Industrial Consultant
A. O. Smith Corp.
New York, N. Y.

Dear Editor:

May I take the opportunity of making this belated comment on the paper by James M. Smith and Richard M. Smith of the Aluminum Co. of America presented at the SAE Summer Meeting at Atlantic City in June entitled "Aluminum Engines-Design for Modern Fabrication." (SAE Journal, August, 1958, pp. 26–29).

I have noted various examples they give of the use of aluminum engines and I wonder why they never mentioned the Marmon 34 which was designed originally around 1911, thousands of which were built. It was a wet-sleeve aluminum engine that gave practically no trouble. Later this was followed by the 16-cyl engine which

continued

For the most effective answers to your bearing problems...

FAFNIR OFFERS THE MOST COMPLETE LINE OF BALL BEARINGS IN AMERICA!

Whatever your bearing needs, your best bet is Fafnir. The reason . . . Fafnir makes America's most complete line of ball bearings, ranging from standard radial to custom-made jet engine types. Various tolerances and combinations of seals and shields enable Fafnir to supply the best bearing for the purpose — the *most* bearing for the money.

Check the Fafnir line first for a quick, effective solution to your bearing problems. Fafnir can deliver in the quantities you require. The Fafnir Bearing Company, New Britain, Connecticut.

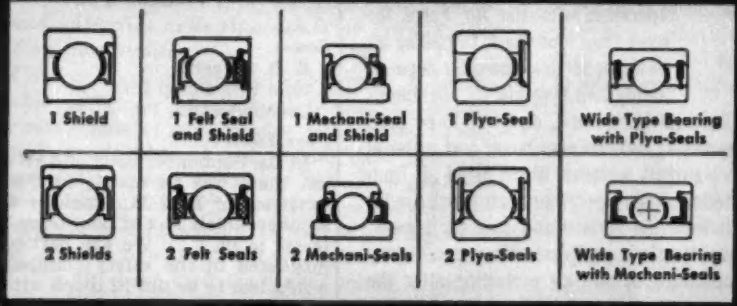
STANDARD RADIAL BEARINGS WITH SAME BORE SIZE!
This feature of Fafnir Standard Radial Bearings simplifies shaft size-bearing capacity problems. You can specify the shaft size, speed, load, service conditions, space and weight limitations and get the Fafnir Ball Bearing to meet your specifications.

TWO BASIC TYPES

Non-filling slot type. Has uninterrupted raceway shoulders and is capable of carrying radial, thrust, or combined loads in any direction. Identified by suffix "K" to basic bearing number.

Filling slot type. Assembled with more balls than K type. Thus in most cases has greater radial load capacity . . . moderate thrust capacity. Identified by suffix "W" to basic bearing number.

SEALS AND SHIELDS IN A VARIETY OF COMBINATIONS



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BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

POPULAR TYPES

Wireloc
(Snap ring type)

Front Wheel

Double Row

CONTINENTAL
Ground Support

Boosts Air Time

Continental's TC-106 turbine air compressor, developed in conjunction with the United States Air Force, is now available for commercial jet liner ground support. The unit, supplying low pressure air, is especially suited to engine starting, cabin air conditioning and actuation of electrical generating equipment for ground operations of the aircraft . . . Continental Turbo-Compressors have been in operation with the Air Force for more than four years, compiling an enviable service record for dependability and long life . . . Continental's new Snow and Ice Removal Nozzle unit, designed to be used with the TC-106 air compressor, reduces man hours and material costs for ice removal from aircraft surfaces. Warm bleed air from the compressor is converted to a high-energy air shaft which erodes through the ice, lifting it from the surface and blowing it away. The Snow and Ice Removal Nozzle is equipped with a glycol spray attachment for quick application of anti-ice protection after the surface has been cleared.

SNOW AND ICE REMOVAL NOZZLE

CONTINENTAL AVIATION & ENGINEERING CORPORATION
12700 KERCHEVAL AVENUE, DETROIT 15, MICHIGAN
SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION

letters from readers...

. . . continued

was also an inserted wet-sleeve design. Many thousands of these engines were in existence and I know some of them are still running.

The reason I am surprised at this is that the castings were made by the Aluminum Co. of America; in fact, the design was effected in conjunction with them, and they were entirely satisfactory in every way.

The engine itself was designed by Howard C. Marmon with the writer assisting. The reasons for this design at the time, of course, are too obvious to need further comment. Of course, there were many other aluminum parts in the car, including the transmission case and part of the rear axle housing and it was perhaps the lightest car of its size that was ever marketed commercially. Possibly it is not too late to call this to the attention of the industry that is now again struggling with the aluminum engine.

. ——— .

From:
A. J. Parsons
Washington, Pa.

Dear Editor:

Your article on German Universal Joints on pp. 42–47, in the September, 1958, issue of SAE Journal, is quite interesting to us. Particularly, we are interested to learn more about the Walterscheid Safety Clutch for power take off drive line.

. ——— .

From:
R. B. Sargent
Hale Fire Pump Co.
Conshohocken, Pa.

Dear Editor:

In the September issue of SAE Journal there was an article by Fred M. Potgieter of Fred M. Potgieter & Associates which was of considerable interest to us. . . . We are particularly interested in the safety clutches and would like to be put in touch with Mr. Potgieter.

. ——— .

From:
M. P. Robinson
Robinson Blower & Engrg. Corp.
San Martin, Calif.

Dear Editor:

We are very much interested in the German Universal Joints described in your article by Fred M. Potgieter on pp. 42–47 of the September, 1958, issue of SAE Journal. . . .

no. 7 OF A SERIES

A "SOUND" APPROACH TO RIDING COMFORT

The "tuning out" of excessive shake and vibration by Oldsmobile engineers produces a comfortable, balanced ride that adds thousands of miles to the life of an automobile.

One of the most critical areas of engineering in today's automobile is "ride". It is critical because an unsatisfactory ride means an unsatisfactory automobile. To produce an over-all balanced and smooth ride, free from harshness and fatiguing vibration, Oldsmobile engineers begin the complex task of "tuning" the car in the early stages of a new model program. Not only is ride important from the comfort standpoint, but an improperly "tuned" car can literally shake itself apart after several thousand miles.

The tuning operation is a series of intricate tests that determine a car's "shake" characteristics—where and how much the metal bends and twists. To produce beaming and torsional moments, a mechanical oscillator is attached to the frame and vibrates the car in a frequency range of 7½ to 15 cycles per second. To measure the displacement of the metal, a velocity pick-up is attached directly to the area under study. As the metal vibrates, a signal is produced by the pick-up and is fed to a vibration meter where it is integrated. The resulting signal is then transmitted to an X-Y plotter that instantly converts it into a continuous magnitude-vs.-frequency trace.

With this valuable information, refining can begin by altering the structure of the various component parts. A complex network of infinite variation must be analyzed intensively to produce the mark of quality that stamps every Oldsmobile.

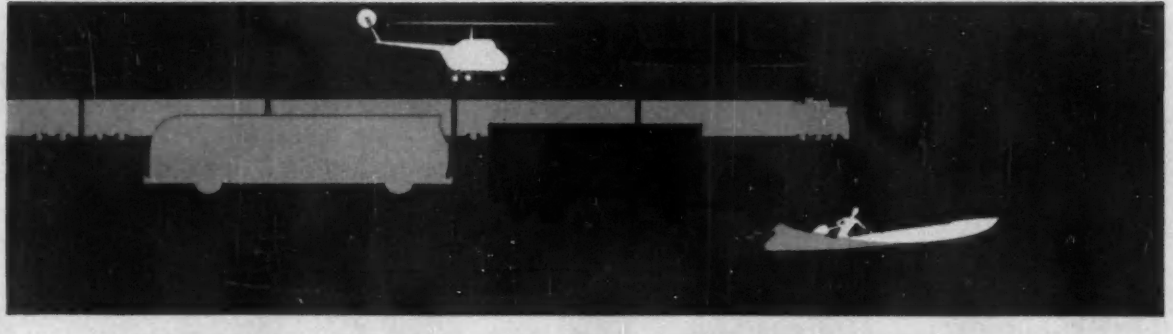
Over the years, Oldsmobile's reputation for quality manufacturing and precision engineering has grown, step by step, until today it is a car of recognized distinction—in a class by itself. Oldsmobile's durability and long service life is further attested to by its continued leadership in resale value. You owe it to yourself to first examine, then test-drive, a truly outstanding automobile—the 1959 Oldsmobile. Visit your Local Authorized Oldsmobile Quality Dealer as soon as possible.

OLDSMOBILE DIVISION, GENERAL MOTORS CORPORATION

OLDSMOBILE

Pioneer in Progressive Engineering ...Famous for Quality Manufacturing

WHEN IT COMES TO DRIVES



ON THESE TYPES OF INTERNAL COMBUSTION ENGINES

YOU START BETTER WITH BENDIX

For nearly fifty years Bendix* Starter Drives have been the recognized standard drive for all types of internal-combustion engines. Besides their more than 125,000,000 automotive installations, these units have also been given top preference in such diversified fields as aircraft, locomotives, earth movers, inboard and outboard marine engines. The reason *has* to be that Bendix drives deliver superior performance and are more reliable. In other words you can start *better* with Bendix.

*REG. U. S. PAT. OFF.

Bendix-Elmira
ECLIPSE MACHINE DIVISION
ELMIRA, NEW YORK

Bendix
AVIATION CORPORATION

New Members Qualified

These applicants qualified for admission to the Society between October 10, 1958 and November 10, 1958. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Atlanta Section

W. W. Williams (M).

Baltimore Section

August Thomas Bellanca (M).

British Columbia Section

Albert James Atkin (J).

Canadian Section

L. C. Ackerman (A), Ewart Brundrett (J), Robert John Eames (J), Gordon A. Ferguson (A), David Scott Fisher (M), Edward Halas (J), Harold Marshall (A), George F. Plummer (A), Edwin John Stefanczyk (J), Robert Earl Woolcott (J).

Central Illinois Section

Albert Henry Cannon (J), George L. Pigman (M), Paul E. Schleder (M).

Chicago Section

Raymond James Birkholz (J), James J. Crowe (M), Edwin Gene Frisbie (J), Frank Nemeth (M), John C. Souders (A), Alva J. Ward (M).

Cincinnati Section

Warren F. Koepsel (J).

Cleveland Section

Robert R. Davidson (J), Roderick G. DuRocher (M), Richard A. Erb (J), Edgar Hylbert, Jr. (M), George Joseph Markovich (J), George R. Norman (M), Wellington G. Scheid (M), Richard M. Smith (M).

Dayton Section

Edwin A. Dahle (M), Joseph A. Hoess (J), Ronald F. McCann (J).

Detroit Section

Harold M. Alexander (M), John Robert Burnett (M), James A. Capolongo (J), Robert W. Chamberlain (J), D. Harold Davis, Jr. (J), Oscar C. Gerkin (M), Charles C. Hagenbuch, Jr. (J), Jon T. Hiles (J), Rudolph Kajor (M), Harry Stanley Kert (J), John L. MacLaren (M), Edward Wayne McKean (A), Thomas S. McMillan (J), Hilary R. Neal (A), Ronald J. Querciagrossa (J), Irving J. Rock (M), William J. Ronan (M), H. Herbert Rudolph (J), Joseph Dennis Ryan (M), Gary L. Schwandner (J), Frederick L. Toal (J), Donald Scott Yordy (J), James E. Zane (M), Edwin C. Zimmermann (J).

Hawaii Section

John F. Maloney (A).

Indiana Section

Odd Hagbard Alme (J), James Dale Matchett (J), Howard M. Stelzl (M).

Kansas City Section

Bernard Harley Brown (A).

Metropolitan Section

Philipp Adolf (M), Eugene G. Caputo (M), Tage Gosta Teodor Karlsson (M), Andrew Kelemen (J), John Lawrence Long (J), Philip M. Strong (J), John E. Thomas (A), Seymour H. Weiss (J).

Mid-Michigan Section

John Gordon Butler (J), Edward L. Clary (M), Walter J. Freiberg (M), Lloyd Joel Lee (J), Vaughan W. Rhoades (J).

Milwaukee Section

John William Bock (M), Ronald R. Hammett (M), Edgar A. Wellens (J).

Montreal Section

Frank P. Lalonde, Jr. (J).

Northern California Section

Arthur Norman Baldwin, Jr. (J), Herbert Dale Millay (J), Wallis K. Mundt (J), James Z. Svoboda (J).

Northwest Section

Paul J. Durning (J), Arthur Edward Eckert (A), John Robert Sheringer (J), John Ellis Turney (J).

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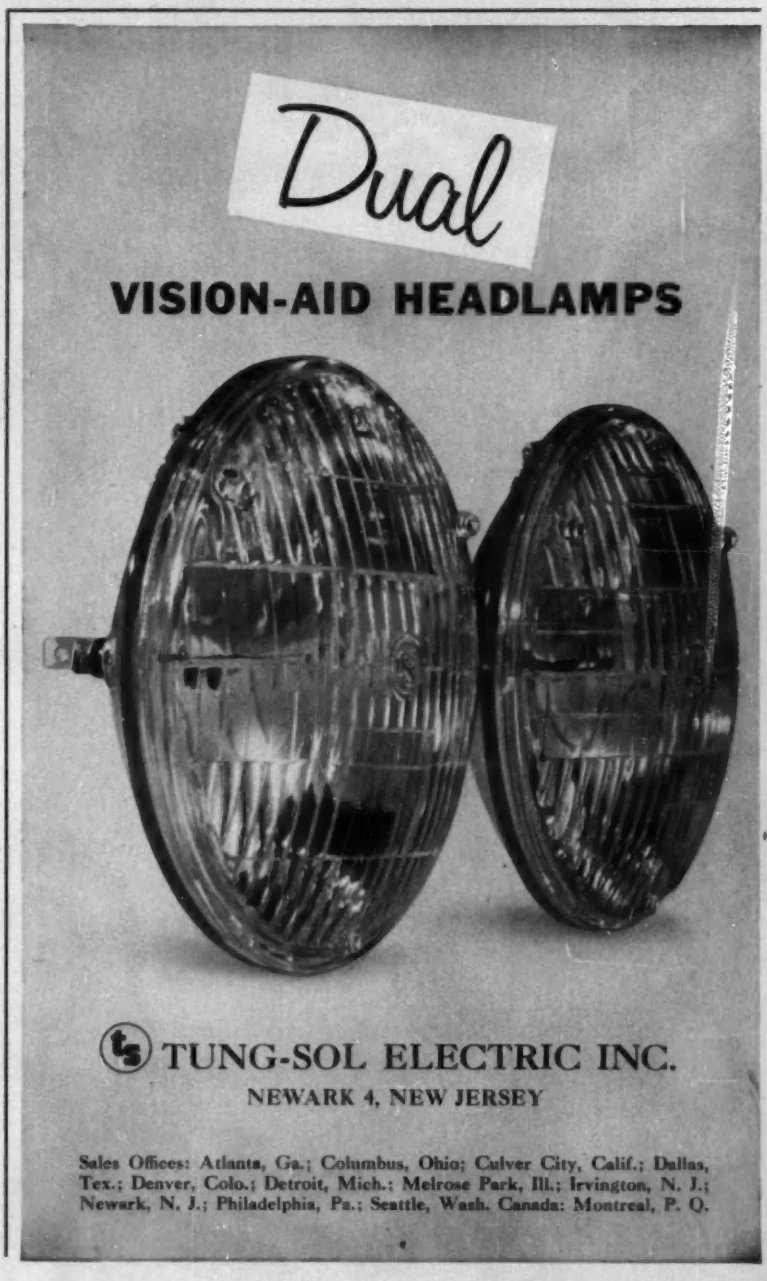
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VISION-AID HEADLAMPS
TUNG-SOL ELECTRIC INC.
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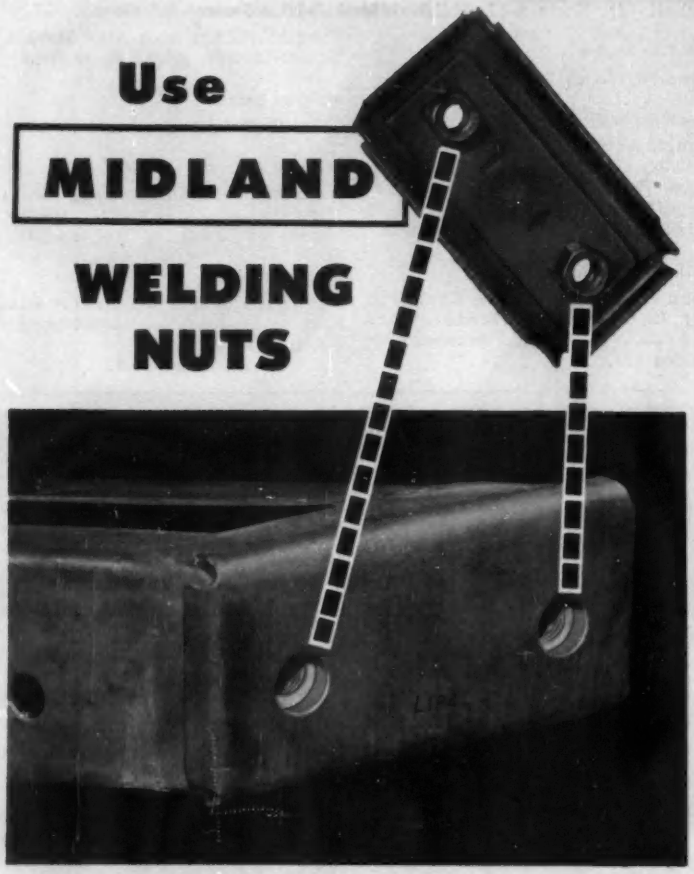
Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Melrose Park, Ill.; Irvington, N. J.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Montreal, P. Q.

Use

MIDLAND

WELDING

NUTS



For Places a Wrench Can't Reach

Before you "button-up" a sub-assembly, make sure Midland Welding Nuts are pre-mounted in places a wrench can't reach. Welded in place, Midland Welding Nuts save time, costs, and the need for a second man at assembly. Quality goes up, too, for Midland Nuts can't come loose or rattle.

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Want cost and time-saving tips? Send for the free booklet showing you how to "Save with Midland Welding Nuts."

MIDLAND-ROSS CORPORATION

WELD NUT DIVISION

6660 MT. ELLIOTT AVENUE • DETROIT 11, MICHIGAN

NEW MEMBERS QUALIFIED . . . . continued

Oregon Section

Dan K. DeSart (A).

Philadelphia Section

Giles Fike (J), George A. Krail, Jr. (J), Ronald Clarke Miller (J), Walter Scott Nissley (J), John J. Plomer (J), David Wayne Steltz (J), Gerald H. Zimmerman (J).

Pittsburgh Section

Pete Christy (J), David Lunifeld (J), Thomas E. Rodwick (J).

St. Louis Section

John B. Balducci (M), Nick H. Eckerle (M), John H. Rohlfs (J).

Salt Lake Group

William H. Riesbol (J).

South Texas Group

Carl A. Hafer (J).

San Diego Section

William Lewis Eckhart (J), Arthur W. Miller (J), Richard Paul Warren (J).

Southern California Section

Arnold J. Bauder (J), D. E. Butler (A), Gale C. Corson (J), Demosthenes Paul Dakos (M), Robert E. Follensbee (J), David Wilbur Frantz (J), James Robert Fryer (J), Philip W. Hampton (J), Erwin Raynor Johnson (J), Charles Chandler King (M), Don J. Lierle (J), William Francis McCann (M), George S. Nakamura (J), James H. Rupert (J).

Southern New England Section

Donald E. Boyce (J), Jesse Gould Haymes, Jr. (M), Thomas A. Mroz (J).

Spokane-Intermountain Section

Kenneth S. Mather (A), Jno H. Turner (A).

Syracuse Section

George W. Douglas (A).

Texas Section

David P. Allen (J), William J. Bramley (M), James R. Moran (M).

Twin City Section

George J. Praska (M).

Western Michigan Section

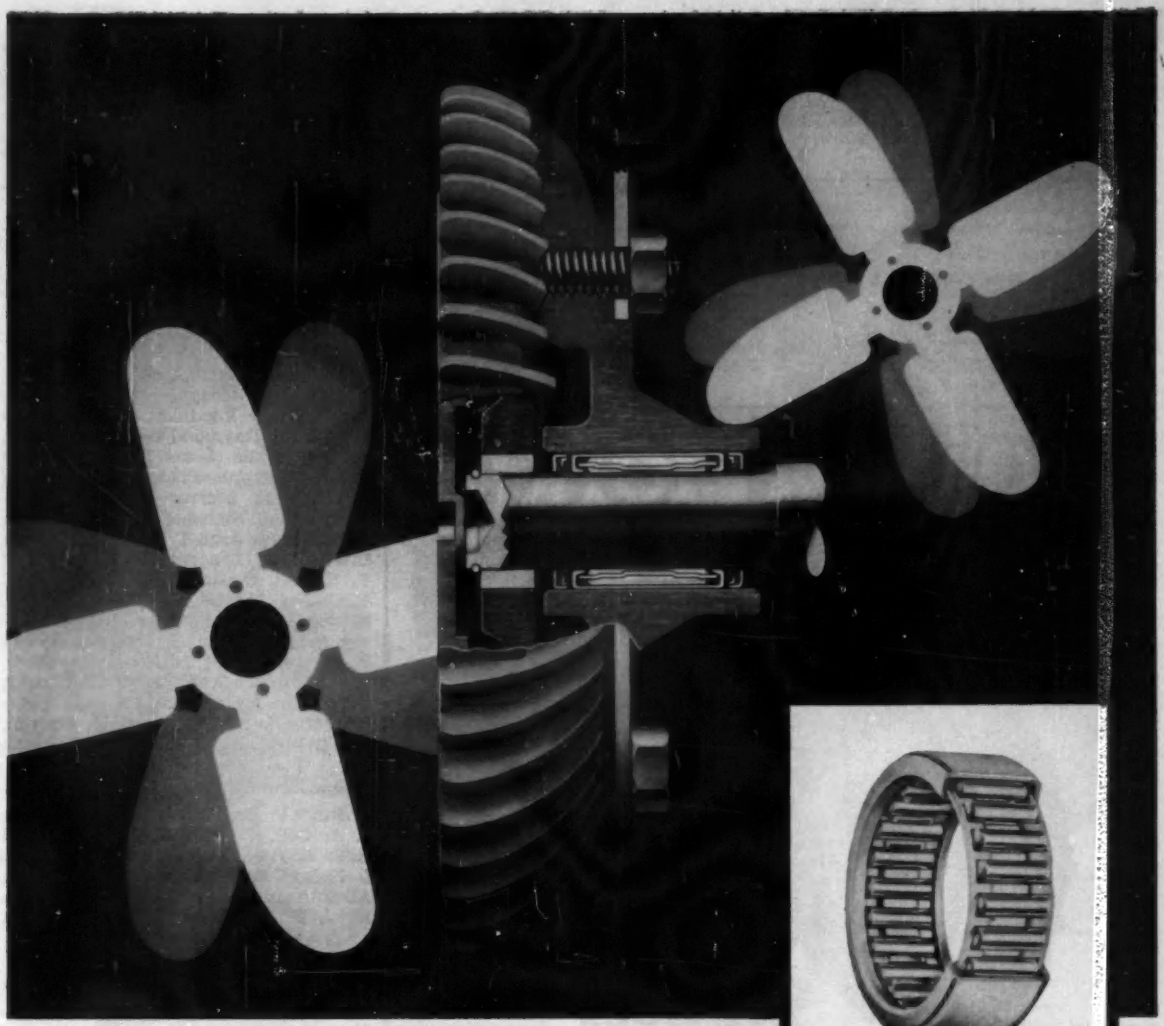
Charles G. Brokowsky (M).

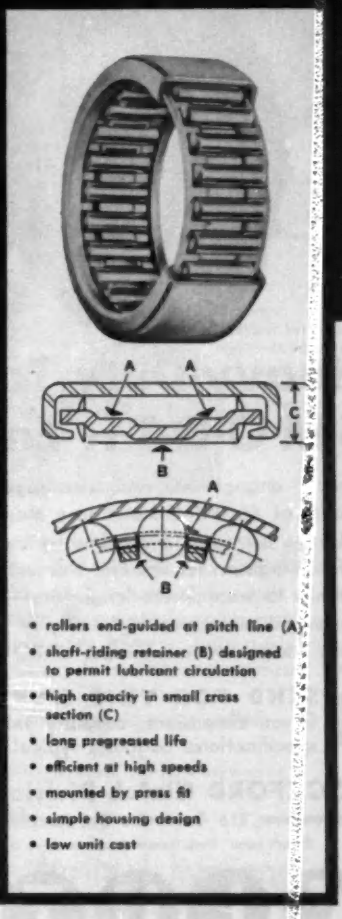
Outside Section Territory

Wilbur M. Davis (M), Clair J. Elgin (J), W. B. Haas (M), Leon E. Hard (J), James George Morrow (J), Raymond R. Perine, Jr. (M), Donald A. Wesley (J).

Foreign

Italo Artus-Martinelli (M), Italy; Willy Kraemer (M), Germany; Walter Edward Withers (M), So. Africa.





- rollers end-guided at pitch line (A)
- shaft-riding retainer (B) designed to permit lubricant circulation
- high capacity in small cross section (C)
- long pregreased life
- efficient at high speeds
- mounted by press fit
- simple housing design
- low unit cost

Schwitzer Variable Speed Fan Drive features new Torrington Bearing for economy, stability, lifetime lubrication

The original design of the Schwitzer Fan Drive, used in passenger automobiles to reduce fan horsepower and noise, called for two ball bearings. By replacing these with one Torrington Drawn Cup Roller Bearing, Schwitzer engineers have simplified the design and reduced costs.

This unique bearing firmly supports the drive housing and fan so they run true despite possible couple loads due to gyroscopic action. Ample lubricant reserve capacity permits pre-lubrication for the life of the fan drive.

Many new opportunities for economy, design simplification and operating improvements are opened up to engineers and designers by the new Torrington Drawn Cup Roller Bearing. Services of Torrington's engineering staff are offered to help you with product development work. **The Torrington Company, Torrington, Conn.—and South Bend 21, Ind.**

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THRUST

Applications Received

The applications for membership received between October 10, 1958 and November 10, 1958 are listed below.

Baltimore Section

Walter John Eser, Jr., Jervis B. Spindler, David A. Surrette

British Columbia Section

Russell Gordon Fraser, Robert Paul Sharman, Claude Robert Usher

Buffalo Section

Peter J. Mutolo, Herbert L. Orwig, Galer N. Wright

Canadian Section

Fred P. Irwin, Robert D. MacLean, Alian Ross Scott, William Hugh Scott, Joseph Walsh, George G. Wellington

Central Illinois Section

Joseph K. Adelman, Walter R. Egged, Earl W. Hagen, Don D. Hamilton, James E. March, Walter Stacy Hulvey, Alan E. Liffengren, Payson B. Palmer, Jr., Robert L. Rodgerson, Glen L. Rogers, Herman P. Siebels, David S. Vinton

Chicago Section

Oscar Henry Banker, Jr., Robert V. Brink, Ernest C. Carlson, Frank A. Doody, Roger Eugene Miller, Philip J. Peterson, James Brown Segallos, Ronald Wade, Frederick Winkler, Jr.

Cleveland Section

John B. Crobaugh, Robert W. Grall, Phillip D. Huculak, Thomas A. Michelhaugh, John Nicol

Dayton Section

James S. Glasgow

Detroit Section

William Dimitt Appleyard, Arthur A. Ash, Jr., Mody Keefer Boatright, Melville Guy Boyd, Jr., Roger L. DeMumbrum, Raymond L. Fales, Jack C. Ferner, Walla Leon Ferris, J. Ray Fullagar, Stephen P. Geoffrey, Kenneth S. Grilleaux, Murray W. Hattin, Edward Haug, Nicholas Hintyes, Jr., R. E. Hoffmann, John T. Huntington, John Bruce Keir, Theodore J. Kona, John T. Kowall, Svein I. Larsen, John W. McCauley, Carl C. Mueller, Denver E. Nichols, Merle R. Osborn, Gerald Garvey Peck, Carlton C. Phillips, Robert F. Pressel, James L. Roush, David C. Salatin, James F. Shuller, John Charles Sobocinski, Raymond J. Tolinski, Theodore N. Tunnecliffe, John H. Warren, Philip West, Kenneth James Williams

Indiana Section

Harry P. Brown, Richard S. Button, J. A. Coll, Charles M. Foote, Donald Allan Harvey, Richard E. Huff, Robert L. Larson, Lauriston Calvert Marshall, Allen Jean Moe, Bernard H. Rullman, Keith D. Scearce, John J. Schoeberle

Kansas City Section

John H. Woodsmall

Metropolitan Section

Edward Boughton, David Fellows, Andre Fonade, Frank J. Kahn, Alan Louis Post, Walter A. Scheland, Stephen J. Smigielski, Dirk W. Van Nest

Mid-Continent Section

W. A. Hager

Mid-Michigan Section

John B. Brennan, Howard H. Gehring, Roland J. Lescelius, Walter E. Welliver

Milwaukee Section

Richard E. Bayerlein, Ronald A. Peterson, Robert Gates Rawson, Richard H. Schwab

Montreal Section

Maurice Turchyn

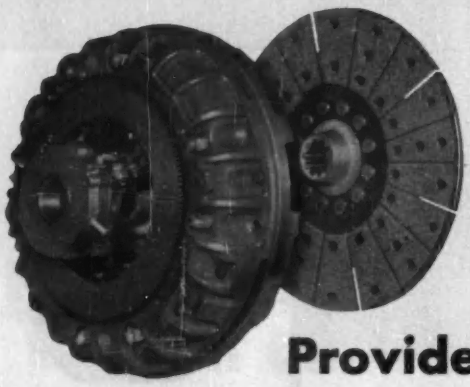
New England Section

Charles William Dietrich, James C. Livengood, Donald James McNutt, Charles F. Springer

continued

ROCKFORD

NEW MORLIFE® CLUTCH FACING

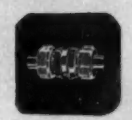


Provides Heavy-Duty Torque with S-M-O-O-T-H Engagement

Smooth engagement and disengagement is a distinguishing quality of this NEW metal-base Morlife clutch facing. It provides the extra torque required by heavy-duty highway vehicles and off-highway equipment. Unusual heat dissipation and resistance to wear insure longer life—with less frequent adjustments and replacements. It will pay you to give *your* products these competitive advantages of ROCKFORD Morlife Clutches.

Small Spring Loaded

Heavy Duty Spring Loaded



Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD Clutch Division BORG-WARNER
316 Catherine St., Rockford, Ill., U.S.A.
Export Sales: Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

AiResearch gas turbines proved most versatile and reliable...

Gas Turbine Power Unit. Aircraft and missile ground support to drive generators, pumps, compressors. Weighs only 45 lbs.
Multipurpose Gas Turbine Unit. Airborne, ground power for heating, cooling, starting, electrical, hydraulics, pressurization of military aircraft.
Gas Turbine Compressor. Powers air transportable pod for engine starting, ground check-out, ice and snow removal.
8,000 now in operation
Gas Turbine Compressor. Standby in-flight pneumatic power for turbine-powered transports.
Gas Turbine Compressor Power Unit. Electrical and pneumatic ground power source for jet transports.
Gas Turbine Generator Set. Primary electrical power for missile launchers, guidance and refrigeration systems.
Gas Turbine Compressor Power Unit. Multiple engine starting, ground electronic cooling, electrical and hydraulic power, trailer or pod mounted.

AiResearch Gas Turbines are used in hundreds of applications: auxiliary power and ground support for missile systems, military and commercial aircraft; main engine starting, electrical and pneumatic power, air conditioning, pressurization, pre-flight check-out, snow and ice removal; prime power for helicopters; variety of ground applications or aboard aircraft for mobile or stationary use.

Advantages: these lightweight units are air transportable as fixed installations, detachable pods or portable vehicles; supply low pressure air and shaft power from 30 H.P. to 850 H.P.; provide variety of electrical power — 9 to 150 KW, 60, 400 and 1200 CPS, AC or DC; have highly refined self-regulating controls and operate in any weather; have instant push-button starting; time between overhauls 1000 hours or 3000 starts.

Your inquiries are invited.

ENGINEERING REPRESENTATIVES: AIRSUPPLY AND AERO ENGINEERING, OFFICES IN MAJOR CITIES

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

THE SHAPE OF THINGS TO COME

Adept in all types of commercial mold making and specialists in figurine molds sold internationally, the Holland Mold Company, Trenton, N.J., is now producing molds for experimental nose cones for guided missiles in conjunction with a Rutgers University governmental test project.

Founder and owner, F. Hollendonner, uses Bestwall Molding Plasters exclusively in making his molds. "Pure, evenly textured and finely ground," says Mr. Hollendonner, "we find we can depend on Bestwall Plasters for good strong molds everytime."

Whether you're shaping "things to come" or the finest figurines, Bestwall Molding Plasters are reliable and versatile. Write for full information or call your nearby Bestwall sales office.

YOUR BEST BUY IS BESTWALL

BESTWALL GYPSUM COMPANY • ARDMORE, PA.
Plants and offices throughout the United States

Applications Received

continued

Northern California Section

Kenneth E. Unmack, William Albert Wallace

Northwest Section

John William Postma, Gary Lee Thomas

Oregon Section

Robert L. Barnes

Philadelphia Section

Clifford Walter Pipowski

Pittsburgh Section

James B. Flint

St. Louis Section

Walter T. Posey, Jack R. Snyder

San Diego Section

James M. Purdon, Jr., William R. Updegraff, Guy Andrew Vince, Harro Zuest

Southern California Section

Michael L. Bower, John Raymond Burrows, Walter T. Camp, A. Gray Fellows, Paul A. Jacobs, Fanning T. Oakley, James Rex Pruett, William A. Rohrer, Peter Scott-Brown, Grant E. Trettel, E. H. Whitney, James P. Woolley

Southern New England Section

Gordon B. Mannweiler

Syracuse Section

J. Warner Heinekamp, Jr.

Texas Section

Merlin Lee Green

Texas Gulf Coast Section

William F. Goins, James E. Nelson, L. T. Thompson

Washington Section

Bernard S. Beavan, Fred C. Fielding, Donald Allen Kaul

Western Michigan Section

Dwight LaBarre

Williamsport Group

William E. Long, John Joseph Penkoske

Outside of Section Territory

Earl G. Heimbach, C. A. Lorenzen, L. Jerome Vogt

Foreign

J. Stanley Clarke, England; William Kennedy, Venezuela; Henry M. Nazarian, Lebanon; C. P. Parankusam, India; Gordon Reynard, England

ENJAY BUTYL fabulous new rubber

Helps new cars ride better

Your ride is smoother, quieter, more comfortable, because today's new cars use Enjay Butyl rubber. It absorbs road shock, cushions vibration, waterseals joints between glass and steel. It also resists aging better than natural and other types of rubber. You'll find Butyl used in more than 100 places in today's modern cars.

ENJAY BUTYL®

ENJAY COMPANY, INC., 15 West 51st St., New York 19, N. Y.

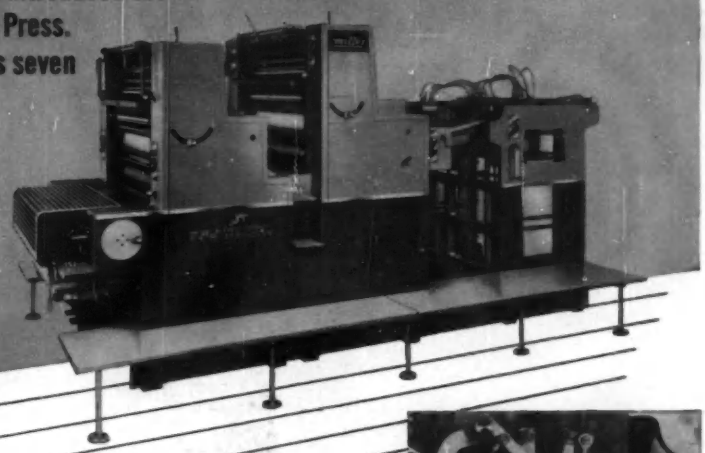
Other Offices: Akron · Boston · Charlotte · Chicago · Detroit · Los Angeles · New Orleans · Tulsa

Misalignment is compensated for *Automatically*

The Miller Printing Machinery Co. has introduced the Miller TPJ Two Color-Perfector Offset Press. In the design of this press, Miller uses seven

HEIM *Unibal*®

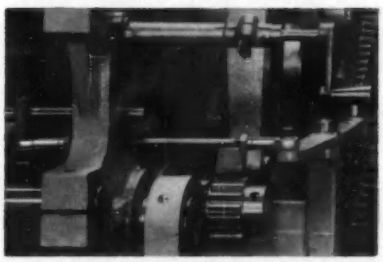
SPHERICAL BEARING ROD ENDS



The TPJ is a sheet-fed offset press which converts from printing two colors on one side of the sheet to one color on both sides of the sheet. It can be switched from one to the other in a matter of minutes. It operates at high speeds and prints sheets up to 23" x 36".

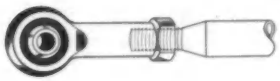
Major section of the first unit trip linkage, where Unibal Rod Ends were chosen to compensate for any slight misalignment, and because they are less expensive than special connections for this application.

These were chosen for several reasons, the principal one being that dimensional and squareness tolerances do not have to be held as close when using the Unibal, as any misalignment is compensated for automatically. The Heim Unibal has a single ball rotating in bronze raceways housed in an outer member or cartridge. The single ball has universal motion to correct misalignment . . . the larger surface supporting area offers greater load ratings for substantially smaller dimensions . . . assembly is simple and fast . . . there is a wide choice of sizes in both male and female types.



Portions of the side guide operating mechanism showing the use of Unibal Rod Ends to connect a walking motion operated by a face cam to a transverse motion.

Heim bearings are sold through the country's leading bearing distributors. Write for complete catalog and/or engineering help.

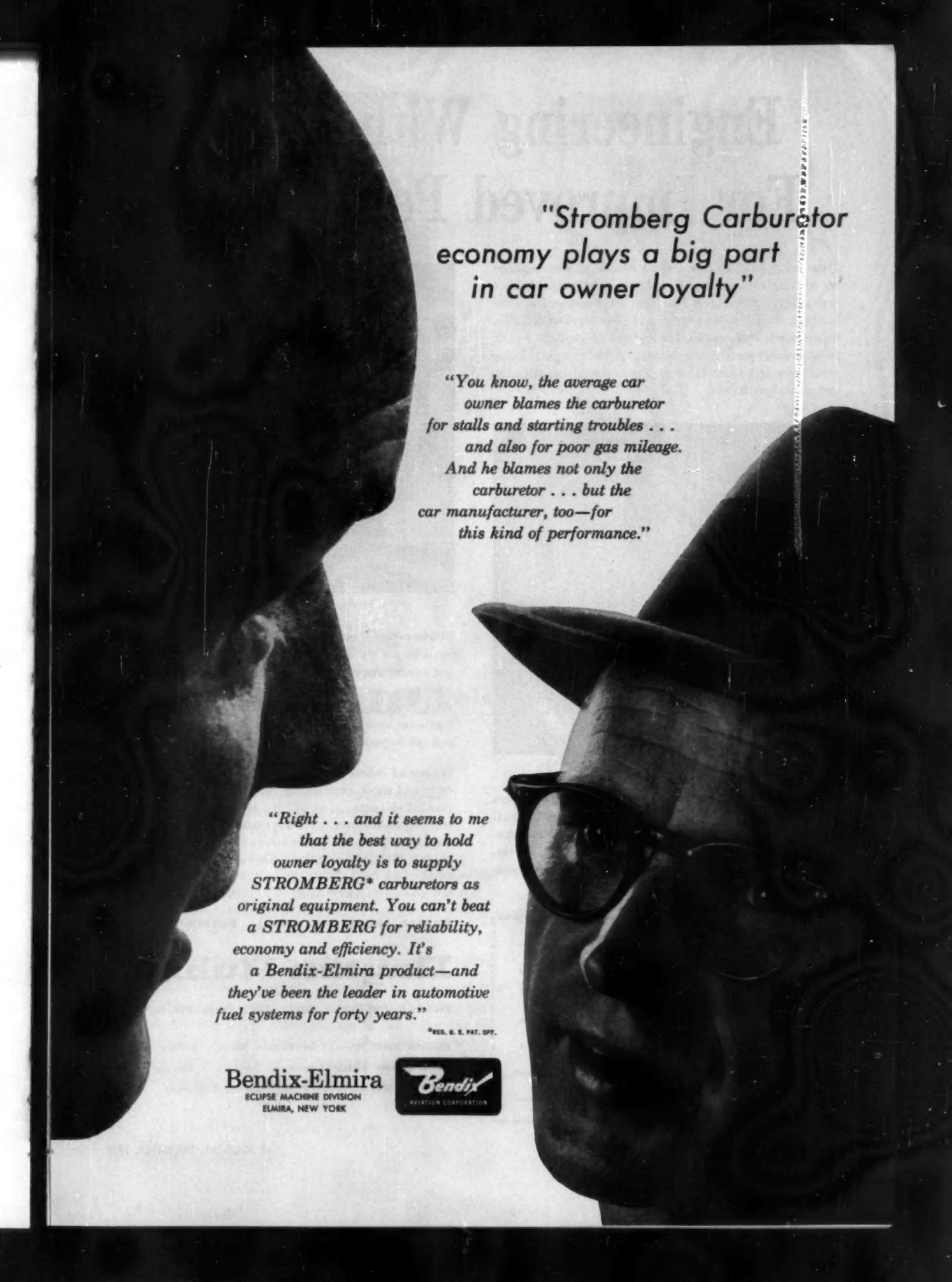


. . . . . .

THE HEIM COMPANY

FAIRFIELD, CONNECTICUT

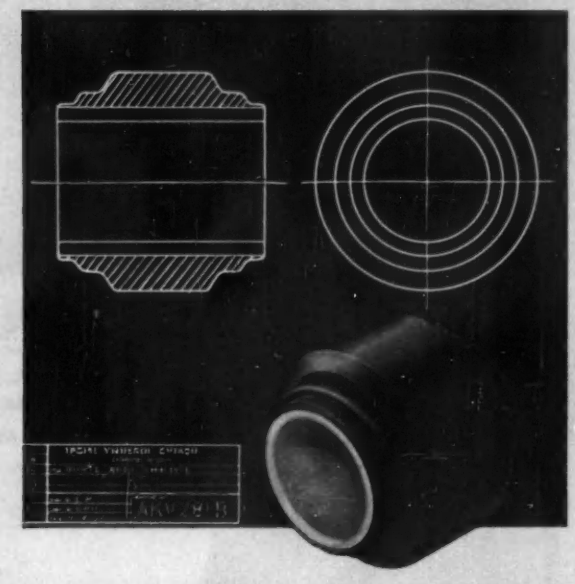
SPECIFY HEIM UNIBAL SPHERICAL BEARINGS AND ROD ENDS FOR ALL PUSH-PULL AND LINKAGE APPLICATIONS AND WHERE MISALIGNMENT MUST BE COMPENSATED FOR


"Stromberg Carburetor economy plays a big part in car owner loyalty"
"You know, the average car owner blames the carburetor for stalls and starting troubles . . . and also for poor gas mileage. And he blames not only the carburetor . . . but the car manufacturer, too—for this kind of performance."
"Right . . . and it seems to me that the best way to hold owner loyalty is to supply STROMBERG* carburetors as original equipment. You can't beat a STROMBERG for reliability, economy and efficiency. It's a Bendix-Elmira product—and they've been the leader in automotive fuel systems for forty years."
*REG. U. S. PAT. OFF.
Bendix-Elmira
ECLIPSE MACHINE DIVISION
ELMIRA, NEW YORK
Bendix
AVIATION CORPORATION

Engineering With Rubber For Improved Performance

These examples show how Dayton molded product engineers are working with mechanical designers to help them achieve new product performance standards. Pre-engineered in combinations of tension, compression and shear for exact deflection requirements, these quality Dayton molded products replace metal-to-metal parts . . . eliminating grease fittings, reducing metal wear and maintenance problems, simplifying assembly, and giving long service.

Rubber tire in this flexible coupling is held by flanges and clamp rings . . . cushions shock loads, reduces torsional vibration, and accommodates angular and parallel misalignment and end float. A transverse split is molded into the tire, permitting replacement without disturbing the shafts. No lubrication is required.



Rubber-to-metal bushing, bonded for life to its inner metal by the quality Dayton process, accommodates torsional and angular motion at the radius rod ends. It provides a flexible pivot joint, eliminating metal wear and lubrication, absorbing shock, noise and vibration. With extreme radial stiffness and maximum torsional flexibility, this bushing is easy to install and can be positioned exactly.

Engineered rubber is the answer to your needs in vibration, noise and shock control . . . inherent misalignment of mechanical elements . . . simplifying assembly problems . . . and reducing maintenance costs. Dayton has design and production facilities to give you complete service from blueprint to finished product. Consult our molded product specialists.

THE DAYTON RUBBER CO., Molded Products Sales Div.
Three Rivers, Michigan

I have a design requirement and would like to talk more about it with one of your sales engineers.

*Name*_____

*Company*_____

*Address*_____

*City & State*_____

RUBBER RUBBER·TO·METAL RUBBER·TO·FABRIC

Dayton Rubber

MOLDED PRODUCTS SALES DIV., Three Rivers, Mich.

BRANCH SALES OFFICES IN: Dayton, Ohio · Detroit, Michigan Hillside, New Jersey · Atlanta, Georgia · Chicago, Illinois Dallas, Texas · Los Angeles, California

ROLLWAY®
Tru-Rol®
BEARINGS

For a sound balance of LOW COST and HIGH PERFORMANCE

When you need maximum precision bearings, buy them. They'll save you money. Rollway has them in all types and sizes.

But in hundreds of applications, maximum precision means *unused* precision. The speed, load and life-expectancy demands are not critical. For these spots, Rollway's Tru-Rol Bearings are engineered to give all that is required in performance at worthwhile savings in cost.

Maximum-Type Design and Construction Principles

The Tru-Rol segmented steel retainer is the strongest, most durable available in commercial-grade bearings. Its separator segments are formed to the curvature of the roller for true axial alignment. In combination with rollers crowned to provide equal load distribution, it withstands heavy shock and reversing loads over long periods.

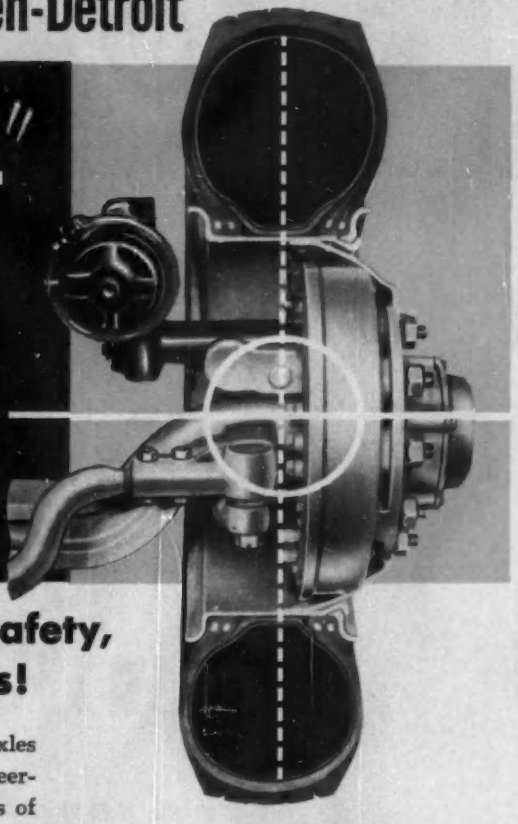
For all the precision and performance you need and can use in non-critical applications, ask a nearby Rollway Service Engineer to brief you on Rollway Tru-Rol characteristics and versatility.

ROLLWAY BEARING COMPANY, INC.
SYRACUSE, NEW YORK

ENGINEERING OFFICES: Syracuse • Boston • Chicago Detroit • Toronto • Pittsburgh • Cleveland Seattle • Houston • Philadelphia • Los Angeles San Francisco

Announcing the new Timken-Detroit®

"center point" steer front axles



for easier steering, greater safety, and reduced maintenance costs!

Timken-Detroit's new "Center Point" Steer Front Axles give your heavy-duty vehicles the advantage of easy steering without the additional weight and cost penalties of power assistance.

With Center Point Design the king pin is perpendicular to the ground, and is moved outward into the wheel. This puts the centerline of the tire and the centerline of the wheel on a relatively common plane. Because the king pin is in a true vertical position, it eliminates the heavy front end "load lifting" that is normally required when turning the conventional axle.

Steering resistance is thus greatly reduced, at no sacrifice in vehicle control. Drivers become less fatigued, safety is increased. And because road shocks and lateral pressures are transmitted more directly to the axle beam, tires and steering parts last longer . . . maintenance costs and downtime are reduced.

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TIMKEN-DETROIT CENTER POINT STEER FRONT AXLES

Give You Three Major Advantages:

Easy steering—less weight, lower cost than with power assistance!

Safer operation—better vehicle control and less driver fatigue!

Reduced maintenance costs—tires and steering parts last longer!

Plants at: Detroit, Michigan
Oshkosh, Wisconsin • Kenton and Newark, Ohio
New Castle, Pennsylvania

PROVED AND PREFERRED...

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

TIMKEN Detroit AXLES
ROCKWELL-STANDARD CORPORATION
TRANSMISSION AND AXLE DIVISION
DETROIT 32, MICHIGAN
The Accepted Standard

Products of **ROCKWELL-STANDARD** Corporation

We are proud that over the years we have been closely associated with Rolls-Royce and Bentley, supplying them with Pistons, Gudgeon Pins and Rings. We also produce the Turbine Blades used in the Rolls-Royce Conway and Dart turbine engines.

The same high standard of craftsmanship and precision engineering goes into all our products for both the manufacturing and replacement trades.

Rolls-Royce Piston and Dart Turbine Blade.

HEPOLITE

HEPWORTH & GRANDAGE LTD.
BRADFORD 4.
Established for over 50 years:-
There is no substitute for experience.

That's one reason why over 50 per cent of all car buyers in a recent nationwide survey said they look for the car with the stainless trim! They know stainless doesn't rust, dent, scratch. They know it comes shining and clean with mere washing. And they know their car will bring more in *resale*, because stainless beauty is *lasting* beauty! The *best* stainless steels are made with Vancoram Ferro Alloys. Your supplier can give you more facts about the added value you can build into your autos — with *stainless steel!* Vanadium Corporation of America, 420 Lexington Avenue, New York 17, New York.

Producers of alloys, metals and chemicals

VANADIUM CORPORATION OF AMERICA

Bushings and Washers *with bearing properties* Give Performance with Economy!

Formed bushings—alloy lined to provide some of the load-carrying characteristics of a bearing—are economical to produce. Oil grooves, holes, pockets, cut-outs, chamfers, straight, lock or special seams can be made in the flat blanks before forming. Available in solid bronze, or steel with babbitt, bronze or aluminum alloy linings, in a wide range of lengths and diameters.

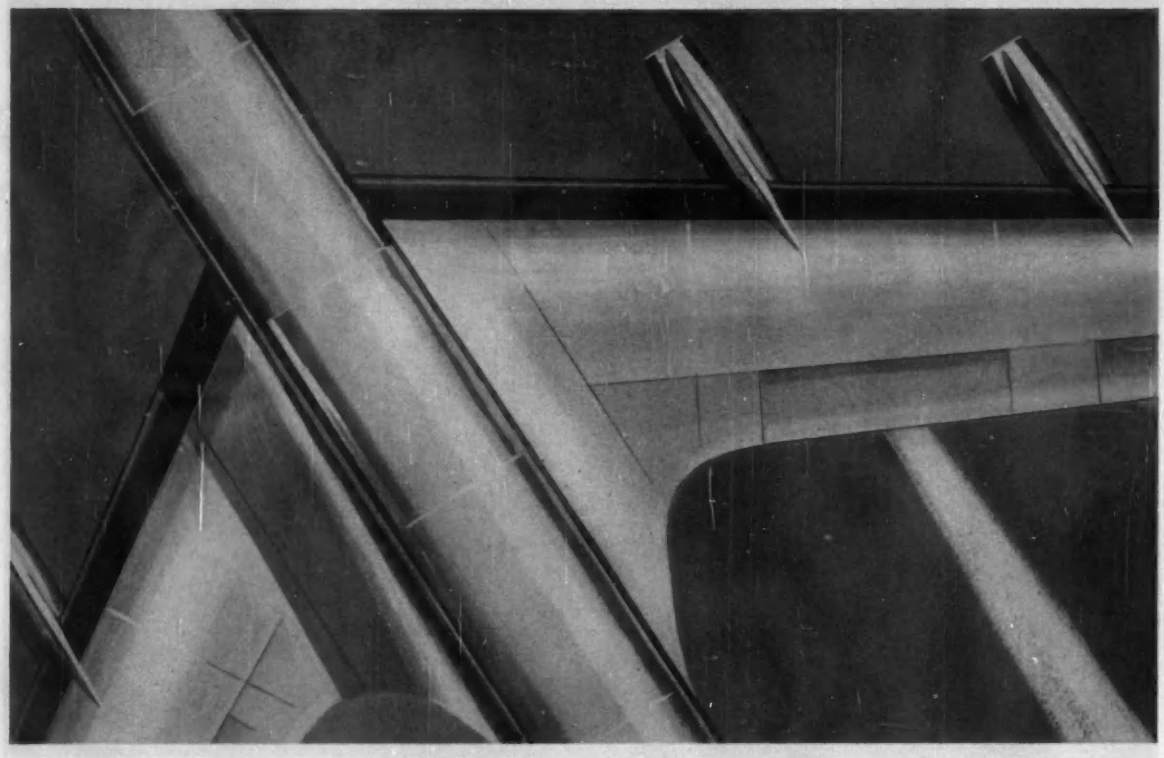
Precision thrust washers of solid bronze, or steel with bronze on one or both faces, may be flat, spherical or special shapes, with grooves, holes, nibs, lugs or scallops. Cold-rolled for exceptional hardness in heavy-duty use. 1″ to 6″ O.D.

Design data sent on request. Complete engineering service. Address:

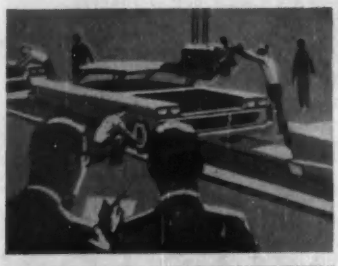
FEDERAL-MOGUL DIVISION

FEDERAL-MOGUL-BOWER BEARINGS, INC., 11035 SHOEMAKER, DETROIT 13, MICHIGAN

Specify the Filter that America Ranks First!



FIRST WITH THE "BOEING 707"—America's first jet airliner! Engines on this giant airliner consume large quantities of fuel which must be finely filtered to assure proper operation. *FRAM filters are chosen to do the job!*



FIRST WITH CAR MAKERS! In today's cars, both oil and air pour through the engine at higher speeds than ever before! This fast-flowing oil and air must be cleaned by filters tailored to each car model. *More car makers install FRAM at the factory than any other filter!*

FIRST WITH DRIVERS! Among the millions of car owners who now know car filters by brand name—*more rank FRAM first in quality than any other filter!*

FRAM ENGINEERS are continually at work developing advanced filtering methods to meet the rigid requirements of today's gasoline, diesel, and jet engines. At FRAM Research and Testing Laboratories, the filtering problems of all types of engine manufacturers are met and solved. For the filter your engine demands, specify the *one* that America ranks first... FRAM.

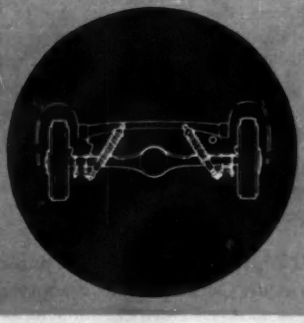
FRAM CORPORATION, PROVIDENCE, RHODE ISLAND

FRAM
OIL AIR FUEL WATER
FILTERS

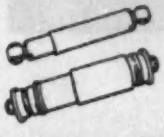
MONROE LOAD-LEVELERS*

the stabilizing units with built-in ride control for a level ride under all road and load conditions

- ✓ **Do the work of elaborate suspension systems —at a fraction of the price.**
- ✓ **Prevent "tail drag", side sway, and "bottoming" on axles.**
- ✓ **Prevent hard steering and excessive tire wear.**
- ✓ **Require no service, and don't interfere with under-body servicing.**
- ✓ **Easily installed as optional equipment at factory or car dealers.**



TYPICAL INSTALLATION: Monroe Load-Levelers are installed in exactly the same position and on the same mountings as the rear shock absorbers. They automatically compensate for all road and load conditions, provide maximum stability.



MONRO-MATIC SHOCK ABSORBERS—Standard on more makes of cars than any other brand.

DIRECT ACTION POWER STEERING—The only truly direct-action Power Steering units available.

MONROE SWAY BARS—Specified as standard equipment on 15 makes of passenger cars.

E-Z RIDE SEATS—Standard on more tractors than all other seats of this kind combined.

MOLDED RUBBER PRODUCTS—Precision-built for all automotive and industrial applications.

MONROE AUTO EQUIPMENT COMPANY, Monroe, Michigan

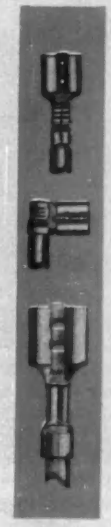
In Canada • Monroe-Acme, Ltd., Toronto

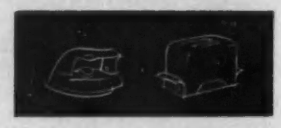
MONROE *World's largest maker of ride control products*

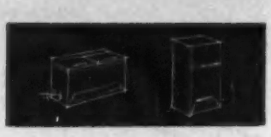
*Trademark

AMP FASTON TERMINALS

The Central Nervous System of Quality Appliances







A-MP Faston Terminals form the ideal nerve center for electrical appliances—sure performance at crucial points during years of vibration and heat.

To help make a better electrical product, the A-MP Faston line offers top performing terminals as well as insulating sleeves, harness connectors, receptacles for .200 tabs, and line splice connectors for every type of appliance. Even when ambient temperatures run as high as 600°F. or when vibration is severe, the manufacturer's reputation is secure with the A-MP Faston product line—accommodating wire size range 22 through 12 AWG.

For added surety, AMP's precision engineered application tooling practically eliminates human error. Our experienced engineering staff can show you the way to low cost modern electrical termination.

Additional information is available upon request.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

THIS IS GLASS

a bulletin of practical new ideas from Corning

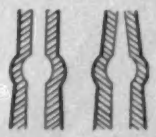
Hot tip!

This is a *glass* welding torch nozzle. You'll find them used on the inert gas welding rigs made by a number of up-to-date manufacturers.

Main reason for the *switch* to glass? You can keep close *watch* over the weld, *avoid* the kind of mistakes that can run into big money when you're working on expensive alloys.

Some of these welding nozzle tips are made out of VYCOR brand glass No. 7913, a 96% silica glass that's been *degassed*. Special firing to remove moisture reduces the tendency to deform at high operating temperatures.

All glass welding tips are fashioned from heavy-wall tubing that could be held as close as ±.001". Also, some pretty fancy machining and forming goes into them. One type calls for precision grinding of an outside taper, another for the same treatment on the inside—both for friction locking. And the tip we make for one firm has a bulb-like configuration to increase gas turbulence. All tips are fire-polished for added strength.



From all we've been able to discover, the men in the shop are quite enthusiastic about these rugged, heat-resistant glass tips that let them watch the welds go by. Likewise for the people who buy these tips from Corning and sell complete rigs to welders. They get what they need, when they need it, at a price that makes sense.

Special glasses, along with special techniques for either custom or mass production, await your appraisal. Which brings us to a standing offer: Bring us your knotty problem—product or process—and we'll see if we can't come up with a *glass* answer.

Or put some data at your fingertips by sending for Bulletin B-91, "VYCOR brand industrial glassware by Corning." In it you'll find all facts about infrared and ultraviolet transmission, heat and chemical resistance, and forms in which you can get these glasses.

How not to foul up the works

It's really very simple: If you're using spun insulation in electric motors, you have to keep the stuff from falling into the moving parts and fouling up the works.

Two things to keep in mind when selecting a material for this application: (1) It has to stand up to quite a bit of heat. (2) It *can't* be a conductor.

Some materials that are good insulators can't take the heat. Others function well at high temperatures but are not insulators.

Glass solves both problems. So, people who make electric motors build them with wedges made from PYREX brand glass No. 7740. (We supply the glass in rod form.)

This particular PYREX brand glass offers a number of useful characteristics. It is corrosion resistant and has a linear coefficient of expansion of 32.5 x 10^{-7} in/in between 0° and 300°C. Dielectric properties at 1 Mc and 20°C. are as follows:

Power factor	.46
Dielectric constant	4.6
Loss Factor	2.1

Wedges made from glass rod support spun insulation in electric motors. Glass is non-conducting and able to stand high temperature without deforming.

You can get PYREX brand glass No. 7740 in a variety of forms—pressed ware, blown ware, plate, tubing, rod and panels.

Mechanical, thermal, electrical, and chemical properties of this glass and 27 others are spelled out in Bulletin B-83. Check the coupon for a copy. Also ask for IZ-1, "Designing With Glass for Industrial, Commercial and Consumer Applications."

Blues in the white

Grand Coulee Dam is quite an impressive sight. It stands 550 feet high, and 4,173 feet wide. At night it's illuminated by 686 high wattage floodlights, covered with *colored front lenses*.

These lenses are red, green, blue, and yellow. And part of the lighting plan requires making *white* by *adding* red, green and blue.

That's where the trouble started. The equipment manufacturer required a very *precise* shade of blue. And despite years of experience in making colored glass, Corning had no blue on hand to do this job.

So our researchers came to the rescue. They developed a *special* glass and called it (for obvious reasons) "Front Glass Blue." Lenses made of this glass produced just the right shade. And along with the red, green and yellow lenses, they were *heat-resistant*, too.

Each lens used in this colorful spectacle measures 18 inches in diameter and weighs almost 7 pounds. All 686 were pressed from *standard* molds, delivered in record time.

O.K., you're not interested in color. Still there might be some glass or glass product that can be of help to you. Good introduction to the fascinating world of glass technology is the booklet, "This Is Glass." In its 64 pages you'll find facts and pictures that might give you some ideas. Remember: Corning can do almost anything with glass.

Corning means research in Glass

CORNING GLASS WORKS, 40-12 Crystal Street, Corning, New York

Please send me: B-91, "VYCOR brand industrial glassware by Corning" ☐ B-83, "Properties of Selected Commercial Glasses" ☐ IZ-1, "Designing With Glass for Industrial, Commercial and Consumer Applications" ☐ "This Is Glass" ☐

Name ..... Title .....

Company .....

Street .....

City ..... Zone ..... State .....

HOW STRONG IS

THE CHAIN?

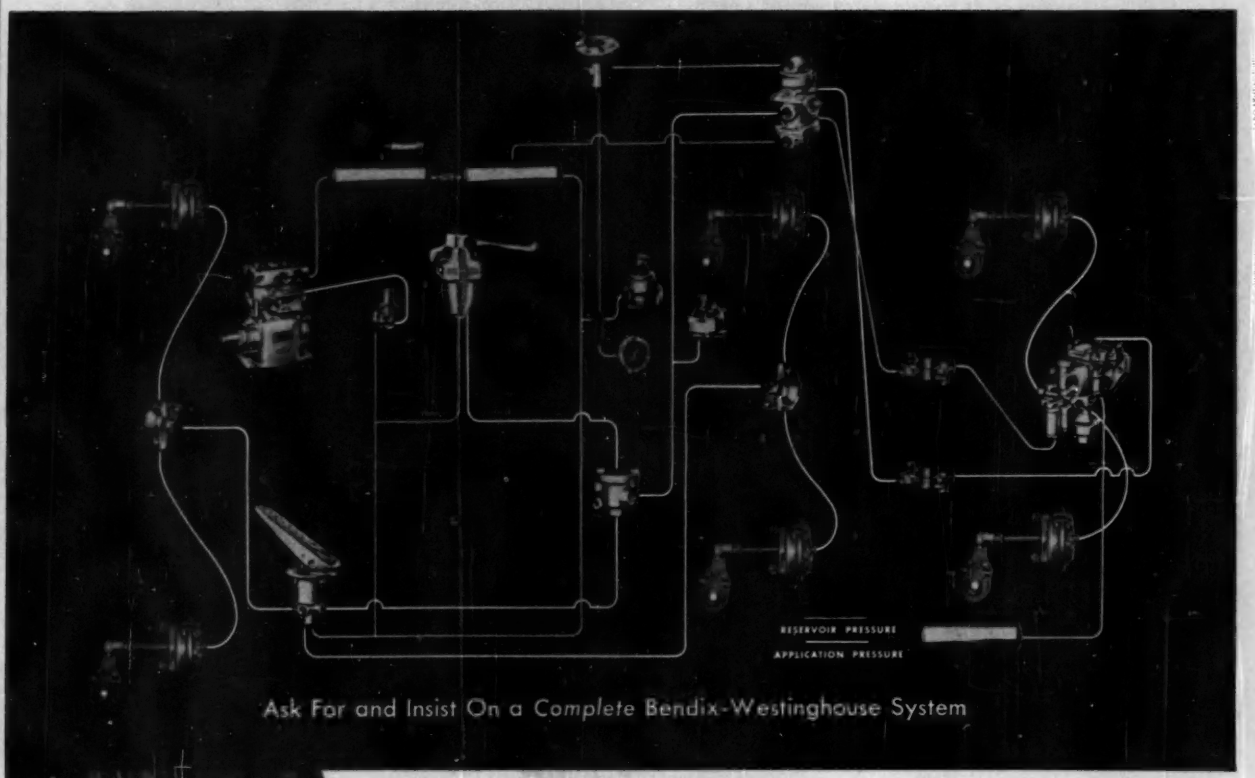
Putting it to the test is one way of finding out. Another, and by far the safest way, is to buy a reliable chain in the first place. A chain with safety-forged, matched links —designed and built to perform dependably under the roughest treatment. This is true also when you buy the chain of devices that comprise an air brake system.

When you specify Bendix-Westinghouse Air Brakes, you can shelve your worries, for you are buying a chain whose proven performance—over more than three decades—is unmatched by any other brake system. It is a *complete* chain because every device, every single component, is designed and built to perform a specific function with peak efficiency in a *closely related* system.

When you buy a *complete* Bendix-Westinghouse Air Brake system you buy a system for whose reliability and long, trouble-free performance we accept full and complete responsibility. Truck and fleet operators know this. That is why more trucks and buses are equipped with *complete* Bendix-Westinghouse Air Brake systems than by all other makes combined.

Another durable link in the Bendix-Westinghouse chain is our nation-wide network of franchised distributors. Anywhere your vehicles go there is a qualified distributor with trained, expert service personnel, and a complete stock of replacement parts to serve your needs. Only Bendix-Westinghouse provides so broad a service. This, plus our economical repair-exchange service, a liberal warranty policy and numerous other exclusives are but a few of the many reasons why it pays to buy air brakes built by Bendix-Westinghouse.

BENDIX-WESTINGHOUSE AIR BRAKES
AUTHORIZED DISTRIBUTOR SALES - SERVICE



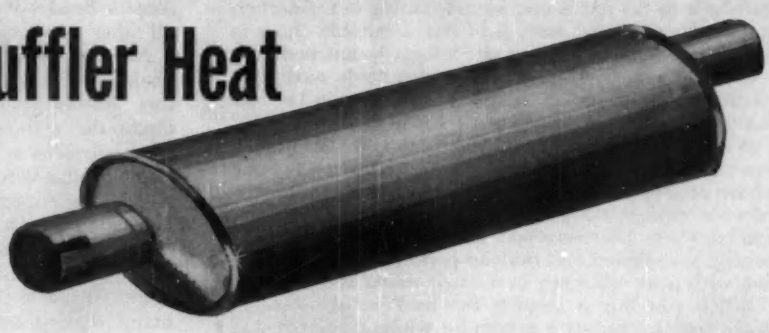
Ask For and Insist On a *Complete* Bendix-Westinghouse System

Bendix-Westinghouse

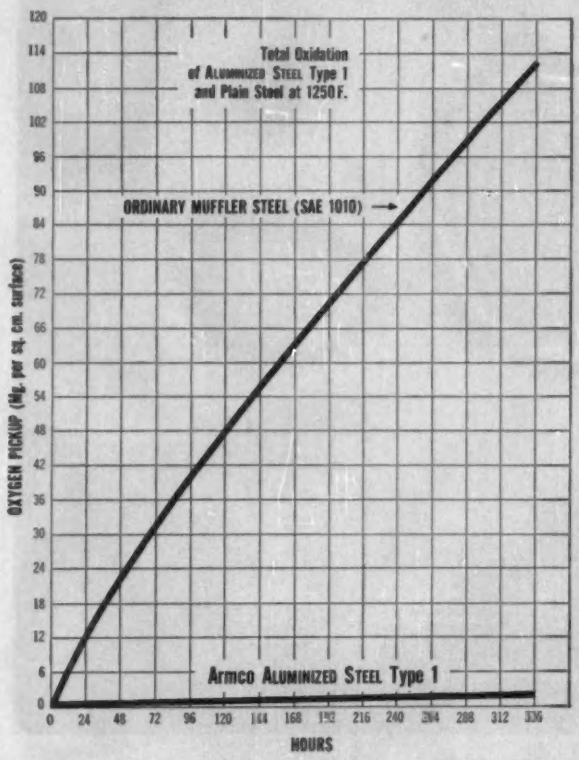
AUTOMOTIVE AIR BRAKE COMPANY

General offices and factory—Elyria, Ohio. Branches—Berkeley, Calif. and Oklahoma City, Okla.

Here's How Well Armco ALUMINIZED STEEL Withstands Muffler Heat



Heat and corrosion, attacking together, are mufflers' greatest enemies. But Armco ALUMINIZED STEEL withstands this deadly combination *longer than any other metal in its price class.*


Total Oxidation of ALUMINIZED STEEL Type 1 and Plain Steel at 1250F.
ORDINARY MUFFLER STEEL (SAE 1010)
Armco ALUMINIZED STEEL Type 1
OXYGEN PICKUP (Mg. per sq. cm. surface)
HOURS
0 24 48 72 96 120 144 168 192 216 240 264 288 312 336
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120

The rate at which hot metal picks up oxygen tells how fast it will fail. These results of heating tests show that Armco ALUMINIZED STEEL Type 1 resists oxidation, while ordinary muffler steel moves rapidly toward failure when exposed to high heat.

Take Heat, For Example

In the test on which the graph is based, ordinary muffler steel and Armco ALUMINIZED STEEL were heated, then cooled . . . over and over again. It's easy to see that the high heat literally "burned up" ordinary muffler steel, while Armco ALUMINIZED STEEL resisted severe damage.

This evidence, plus the fact that Armco ALUMINIZED STEEL also resists corrosive exhaust gases, tells why mufflers made of Armco ALUMINIZED STEEL outlast ordinary carbon steel mufflers *at least 2-to-1* on the average. Early failures are fewer. Mufflers are more likely to span the vital first-owner period.

Why not get complete details about this hot-dip aluminum coated steel. Just mail the coupon or phone your nearest Armco Sales Office.

* * *

Other Armco Steels for top-quality automotive products include: Stainless Steels, ZINCGRIP®, ZINCGRIP PAINTGRIP®, Cold-Rolled PAINTGRIP, Long Ternes, Steel Tubing, and high-quality Hot- and Cold-Rolled sheets.

New steels are born at Armco

ARMCO STEEL CORPORATION, 2308 Curtis St., Middletown, Ohio

Please send more information about ALUMINIZED STEEL Type 1.

NAME

TITLE

FIRM

STREET

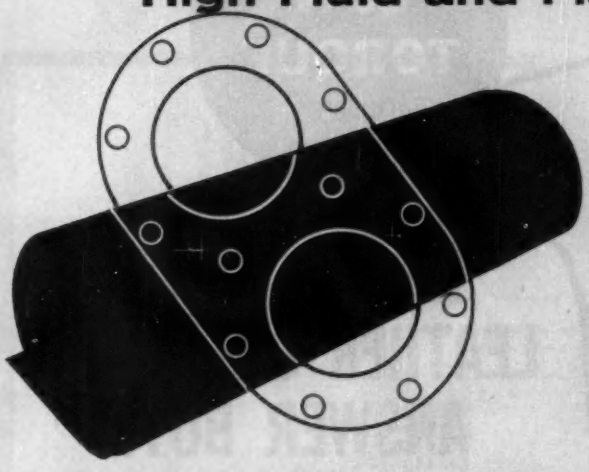
CITY ZONE STATE

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

VICTOPAC

Asbestos-Synthetic Rubber Gasketing
Durable under Heat, High Fluid and Flange Pressures



Seals against oil, engine fuels (liquid or vapor) and coolants, steam, hot or cold water

Supplied in Sheets . . . or Finished Gaskets
Made in standard thickness:
1/64″—1/32″—1/16″—3/32″—1/8″

This tough, completely homogeneous sheet packing is composed of long-fiber asbestos and synthetic rubber, bonded under heat and pressure.

While thoroughly dense in structure, Victopac has sufficient compressibility for effective sealing under light or heavy flange loading. Its resistance to heat permits usage where plant fiber packings deteriorate.

Made in 7 types — Typical uses

Victopac is widely specified for automotive and industrial machinery applications. Choice of seven basic types provides economical sealing for each use. All types conform to SAE-ASTM specifications and are certified to federal, military or customer specifications where needed.

Typical applications include speed reducers, transmissions, differentials, gear case covers, pipe flanges, refrigeration, pumps, oil coolers, internal combustion engines, etc. Victopac's uses are almost unlimited.

Test samples supplied free

Your inquiry, stating proposed application, will bring you sample sheets of recommended type with full technical data. Request through your Victor Sales Engineer or directly to factory.

Victopac is available in sheet sizes 58″ x 62½″ and 58″ x 125″. Write for special price list.

Victor Mfg. & Gasket Co., P.O. Box 1333, Chicago 90, Ill. Canadian Plant: St. Thomas, Ont.

CONDENSED SPECIFICATIONS

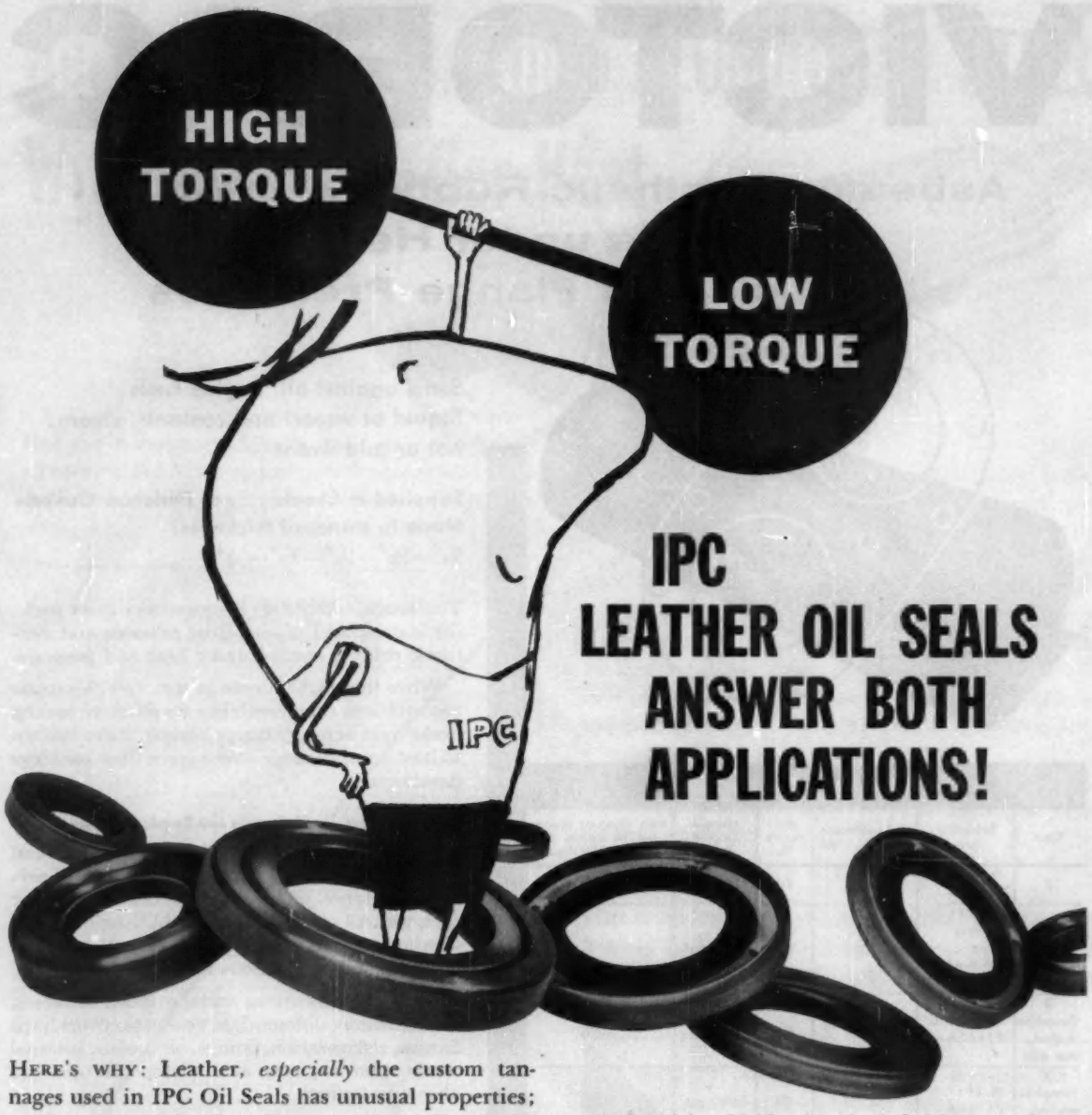
Type	SAE-ASTM Spec.	% Compression 5000 Psi. Load	Recovery %	Minimum Original Tensile	Max. Thickness Change in ASTM Oil No. 1— 5 hrs. at 300 deg. F.
1	G-1111-1 *P1161A	12±5	40	1800 psi.	20%
1B	G-1111-1 (Federal Spec. HH-P-46A *P1161A	12±5	40	1800 psi.	20%
2 Graphite coated, one side	G-1111-1 *P1161A	12±5	40	1800 psi.	20%
3 Graphite coated, two sides	G-1111-1 *P1161A	12±5	40	1800 psi.	20%
50V	G-1122-1 (AMS 3232F) (Navy Spec. 33-P-13c) *P1141A	12±5	40	2000 psi.	10%
60V	G-1123-1 (AMS 3230 and 3231) *P1151A	12±5	40	2000 psi.	15%
70V	G-1122-1 (AMS 3232F) *P1141A	12±5	40	2000 psi.	10%

*Latest ASTM No. D1170-58T, SAE No. 90R and MIL-G-12803A specifications.

VICTOR

Sealing Products *Exclusively*

GASKETS • PACKINGS • OIL SEALS • MECHANICAL SEALS



IPC LEATHER OIL SEALS ANSWER BOTH APPLICATIONS!

HERE'S WHY: Leather, *especially* the custom tannages used in IPC Oil Seals has unusual properties; . . . for example it offers dimensional stability, *and a great torque range* . . . with the result that IPC Leather Oil Seals meet torque conditions from minimum up to 2-3 times normal.

IPC Leather Oil Seals have high abrasion resistance . . . are ideal for slow speed applications on rough shaft finishes (up to 60 micro-inch). Where higher speeds are a factor, IPC Leather Seals are performing well at speeds up to 2000 feet per minute . . . on shafts with a 24-32 micro-inch finish . . . and temperatures up to 248° F.

How about low friction? . . . The IPC Leather Oil Seal has a distinctive edge . . . can be furnished with numerous types of treats or impregnates tailored to solve your specific problem.

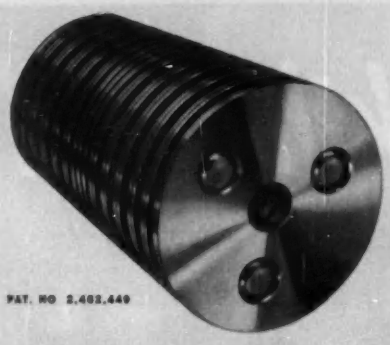
Why not look into IPC Leather Oil Seals soon? This custom approach to sealing problems is your best assurance of quality.

Packings
Oil Seals
Precision Molding

IPC INTERNATIONAL PACKINGS CORPORATION

Custom designed . . . for your application.

Bristol, New Hampshire P-6



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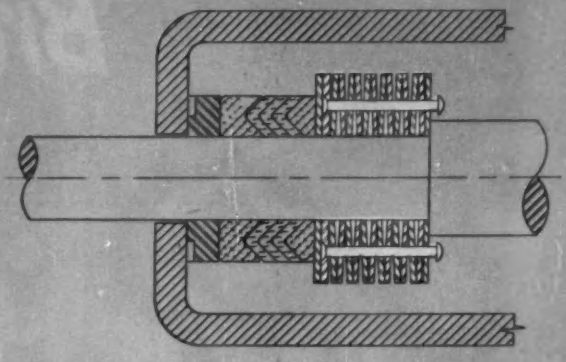
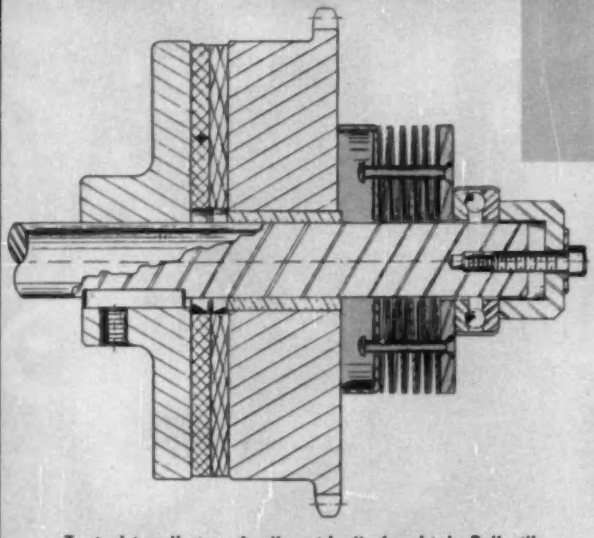


Typical installation of a "cartridge" of multiple Belleville washers in a shaft seal.



Typical installation of a "cartridge" of multiple Belleville washers in a clutch, such as in a machine tool drive.

Some uses of Belleville Washers as a spring ENERGY CARTRIDGE

Where loads are high, operating space limited, and conventional spring forms fail to qualify, Belleville washers in the form of an Energy Cartridge can be a welcome solution. Two such conditions are illustrated here.

By preassembling the washers in a single compact unit held together by pins or posts, installation is simplified and error is prevented in stacking loose washers in sequence. For varying loads, many combinations are available: in series, parallel or parallel series.

Belleville washers may be used for vibration isolation, as spring mountings for punch and impact presses, or to maintain constant pressure. For further information, write for pamphlets "Belleville Springs" and "Energy Cartridge." For engineering and production assistance on large or small requirements, contact the nearest A.S.C. Division listed below.

Associated Spring Corporation

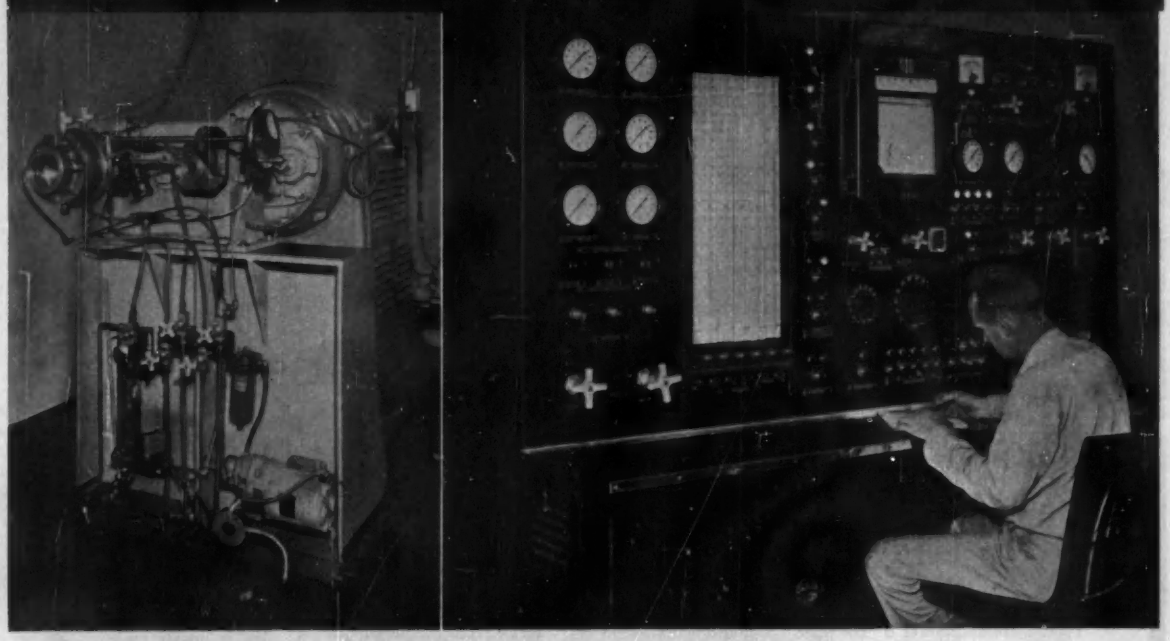
General Offices: Bristol, Connecticut

Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
B-G-R Division, Plymouth and Ann Arbor, Mich.
Gibson Division, Chicago 14, Ill.
Milwaukee Division, Milwaukee, Wis.
Raymond Manufacturing Division, Corry, Penna.
Ohio Division, Dayton, Ohio
F. N. Manross and Sons Division, Bristol, Conn.
San Francisco Sales Office, Saratoga, Calif.
Seaboard Pacific Division, Gardena, Calif.
Cleveland Sales Office, Cleveland, Ohio
Dunbar Brothers Division, Bristol, Conn.
Wallace Barnes Steel Division, Bristol, Conn.

Canadian Subsidiary: The Wallace Barnes Co., Ltd., Hamilton, Ontario and Montreal, Quebec

8812

Breakthrough



New C/R high-speed laboratories ...testing seals at tomorrow's speeds!

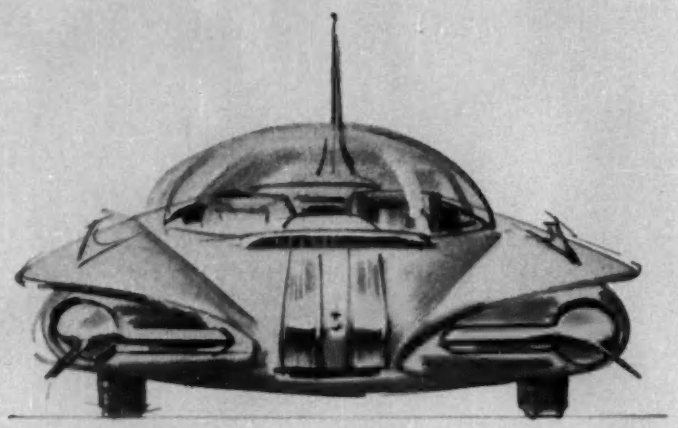
Pushing a design program through on schedule means that there can be no slow-down in any phase. If you know there's a high-speed sealing problem ahead — an accessory drive for a new jet, a hot, fast-rotating shaft in a guided missile, or a bearing in tomorrow's turbine car—plan for it now. Here in Chicago Rawhide's new High-Speed Seal Test Laboratory, C/R engineers now are breaking through present limits, evaluating the design and performance of advanced seal types such as end face, controlled gap, bellows, segmental and bore type seals under such punishing conditions as 80,000 R.P.M., –300° to +1000°F. and 500 psi. C/R is at your service *now* with the most advanced technology and facilities in the country for cooperative research on high-speed sealing problems.

Chicago Rawhide consistently gears itself to the future, ready to meet industry's new problems as they develop today. May we help you?

More automobiles, farm and industrial machines rely on C/R Oil Seals than on any similar sealing device.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1243 ELSTON AVENUE • CHICAGO 22, ILLINOIS
Offices in 55 principal cities. See your telephone book.
In Canada: Manufactured and Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario.
Export Sales: Geon International Corp., Great Neck, New York
C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

OIL SEAL C/R DIVISION
CHICAGO RAWHIDE



PUROLATOR'S DRY TYPE AIR FILTERS GIVE

COMPLETE DESIGN FREEDOM

With Purolator's new dry type air filters, there's no need to keep a constant, level bearing . . . to set the air cleaner on top of the block. There is no oil to spill, no level to be maintained. This makes it possible to place the filter anywhere at all . . . under the engine, on the side . . . wherever it allows the most design freedom.

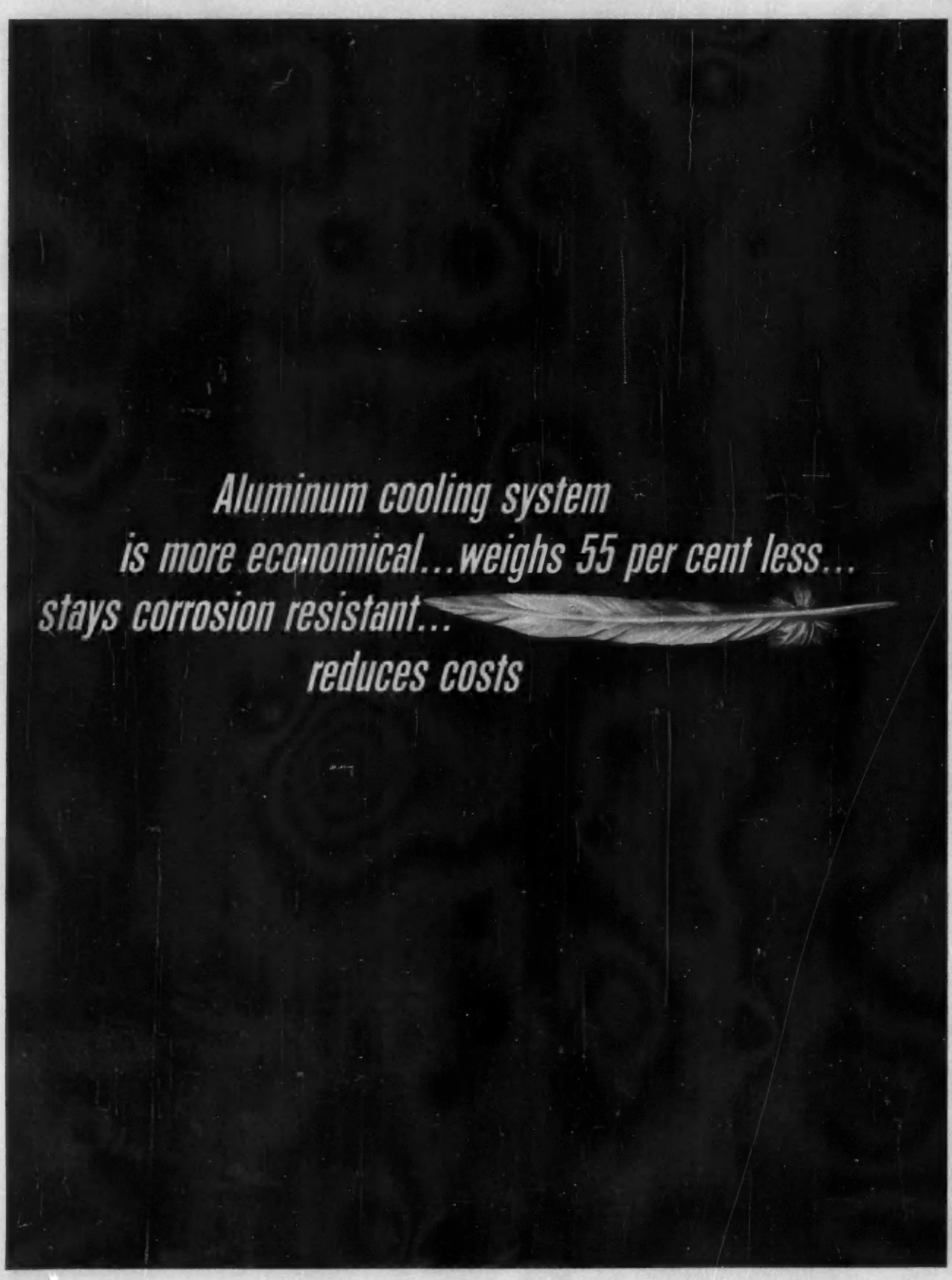
Of course, the big advantage in dry type filtration is the optimum efficiency it affords. The Micronic dry type element is just as effective at low speeds as at high speeds. And instead of becoming less efficient with use, its already outstanding 99% efficiency *increases* to 99.7%.

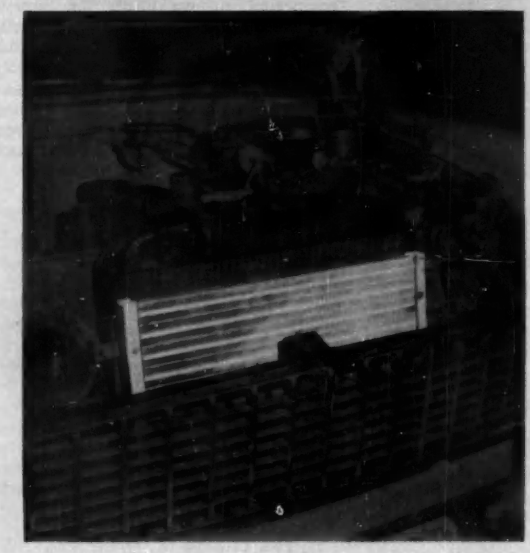
Design your cars the way you want them . . . then call on Purolator to design and produce the air filter to fit your design.

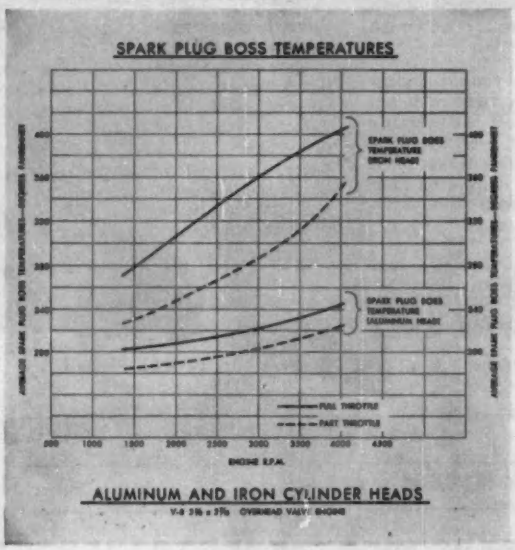
Filtration For Every Known Fluid

PUROLATOR
PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA


Aluminum cooling system
is more economical... weighs 55 per cent less...
stays corrosion resistant...
reduces costs





Over 14 years ago, Alcoa's automotive and research engineers focused their efforts on the development of a more efficient cooling system—a cooling system to lick the twin problems of weight and corrosion. Today aluminum cooling system components are a practical reality and foreshadow the all-aluminum system of the future. They point the way to more horsepower per pound, better weight and temperature distribution.

Alcoa Successfully Applies Aluminum in Cylinder Heads, Water Pumps, Heat Exchangers. Through design improvements and alloy development, Alcoa provides weight savings of more than 55 per cent with substantial savings in cost. The aluminum head assembly provides superior heat transfer—valves run cooler and seat better, spark plug boss temperatures are reduced by as much as 165°.

In Service Tests and Field Experience. Alcoa engineers investigated cooling system parts under the most severe conditions. They found that under the usual circumstances no change needed to be made in operating practices. While iron parts need constant protection by corrosion inhibitors, aluminum cooling system components experience comparatively little attack by most coolants. Where applications involve the use of iron and aluminum parts, proper choice of aluminum alloy and design features reduce corrosion and erosion.

Let Alcoa Help. Alcoa's work in the development of the all-aluminum engine and cooling system has resulted in a wealth of accumulated experience in the application of aluminum in the automotive field. Bring your design and application problems to Alcoa. Its engineers and complete facilities are yours to tap. Let us work with you. Write Aluminum Company of America, 1844-M Alcoa Building, Pittsburgh 19, Pennsylvania.

Water pump cover. This die-cast aluminum part, together with the aluminum front cover and pump housing, lends itself to more economical volume production techniques.

An all-aluminum condenser for automobile air-conditioning units. Core weighs seven pounds, depth less than an inch. Aluminum fin stock and rectangular tubes provide lightness, best heat conductivity.

Thermocouple readings taken in Alcoa Process Development Laboratories reveal aluminum's superior thermal conductivity for improved performance. Besides reducing temperature level, aluminum holds temperature range to 60° from part load to maximum horsepower.

ALCOA ALUMINUM GIVES *EVERY* CAR MORE GLEAM AND GO

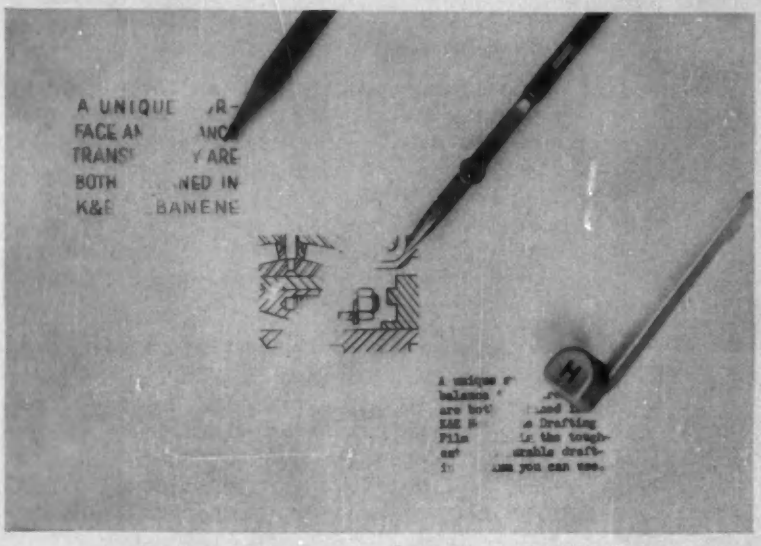
ALCOA ALUMINUM

ALCOA THEATRE
Fine Entertainment
Alternate Monday Evenings

Some Ideas

for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.



Now you see it . . . now you don't. Pencil, ink and typing all register sharply, erase completely on the K&E "engineered surface."

The K&E "Engineered Surface"

All K&E paper, cloth and film has one extremely individual characteristic. It's what K&E calls its "engineered surface"... a unique surface designed and applied by K&E, right in its own plant, to every roll and sheet of prepared tracing paper, cloth and film. It means controlled drafting qualities far beyond anything the base material alone can normally provide, with a surface tooth that's exactly right and uniform. Whatever's penciled, inked or typed onto it goes on crisply and sharply . . . shows up clearly and stays that way. Furthermore, the "engineered surface" lets you erase if you want to, easily and quickly and without any of those leftover ghost lines that drive you crazy when they show up in reproductions. And remember, only with K&E do you get all the advantages of an "engineered surface," no matter which paper, cloth or film you're interested in.

About HERCULENE (TM) The Newest of Films

Frankly, we think K&E Herculene Drafting Film is a real discovery. It has all the properties of the K&E "engineered surface" . . . exceptional "take," adhesion and erasability . . . plus the toughness and durability of its Mylar® base. What's the latter? It's a polyester film, developed by DuPont, that's uncommonly strong and virtually indestructible . . . waterproof and almost immune to the effects of age, heat, ultraviolet exposure and handling. With our K&E "engineered surface" added, it becomes K&E Herculene Drafting Film . . . the toughest, most durable drafting medium yet to reach the drafting room. And the surface will last indefinitely, without flaking off or chipping off.

Some Points About Paper...

K&E Albanene® Tracing Paper is the largest selling tracing paper in the world today. Why? Because Albanene is the *only* prepared tracing paper which has an "engineered surface." All other brands depend for their pencil tooth solely on the natural surface texture of the paper itself, which varies from fine to coarse . . . often on the same sheet.

Albanene invariably gives you sharp, clear pencil lines, superb reproductions. It has a solid transparentizer that is chemically stable and can't leak out, ever. This permanent transparentizing means that you'll never get white, opaque spots, even from contact with drafting tape. Try the drafting tape test yourself.

...and its package

And now, all Albanene paper in rolls is packaged in the new square carton for better protection and easier storage. Your rolls stay neat and clean while in use, and the cartons will do double duty in helping you to store finished tracings. In fact, some companies are rearranging their filing systems by using Albanene cartons, which hold large numbers of rolled-up drawings and stack simply and neatly.

Some Facts About Cloth

When you want cloth, think first of K&E Phoenix® Tracing Cloth. Besides the K&E "engineered surface" with the superb "take", adhesion and erasability for pencil, ink or typing, K&E Phoenix has all the advantages of a water-resistant, chemically-inert coating that won't soften even under high heat and won't discolor, become brittle or flake off the base. You can even clean both sides with a damp cloth, without worrying about moisture stains.

And Some Tips On Erasing

All K&E drafting media give you excellent erasability, but there's a right way to erase on each one. On cloth and film, harsh, gritty erasers can destroy the surface. You'll get the best results with plastic erasers, such as the Richard Best "Tad" and the Eberhard Faber "Race Kleen." Moisten them for removing ink and stubborn typing; use them as they are for removing pencil lines. Large areas of ink can be removed completely without damage by using a moist cloth and Bon Ami cleanser. On Albanene, electric erasing machines are fine if used with a soft eraser.

The Choice Is Up To You

When it comes to selecting K&E paper, cloth or film for the job at hand, we have to leave the choice to you. We're not being indecisive . . . it's just that you're the only one who knows the particular problem you have and which product solves it best. But remember . . . K&E has a *complete* line of paper, cloth and film . . . and only K&E puts a special "engineered surface" on all three media to provide a well-balanced, uniform surface suited to the base material.

KEUFFEL & ESSER CO., Dept. SJ-12 Hoboken, N. J.

Please send me more information and samples on the following:

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_____ 1277

Next ... full seating in comfortable, economical URETHANE FOAM!

(Based on NACCONATES® Diisocyanates)

Either molded or fabricated from slab stock, automobile seats made entirely of urethane foam promise substantial savings in production time and labor. Yet urethane equals or surpasses any previous construction in comfort and all-around performance.

Urethane can combine showroom comfort with minimum road jounce. It eliminates fear of bottoming . . . reduces the sidesway in cornering that is usually associated with foam.

Our application laboratories are currently engaged in research on molding and testing urethane seats for automotive use. We will gladly work with automotive designers and engineers in furthering this development.

Urethane resists sun, heat, weather. Unaffected by cleaning solvents and detergents used on fabrics
Labor-saving, by foaming-in-place against vinyl, leather and other outer coverings is an early prospect.
Increased load-bearing capacity in slimmer seat cushion gives added headroom.

NATIONAL ANILINE DIVISION
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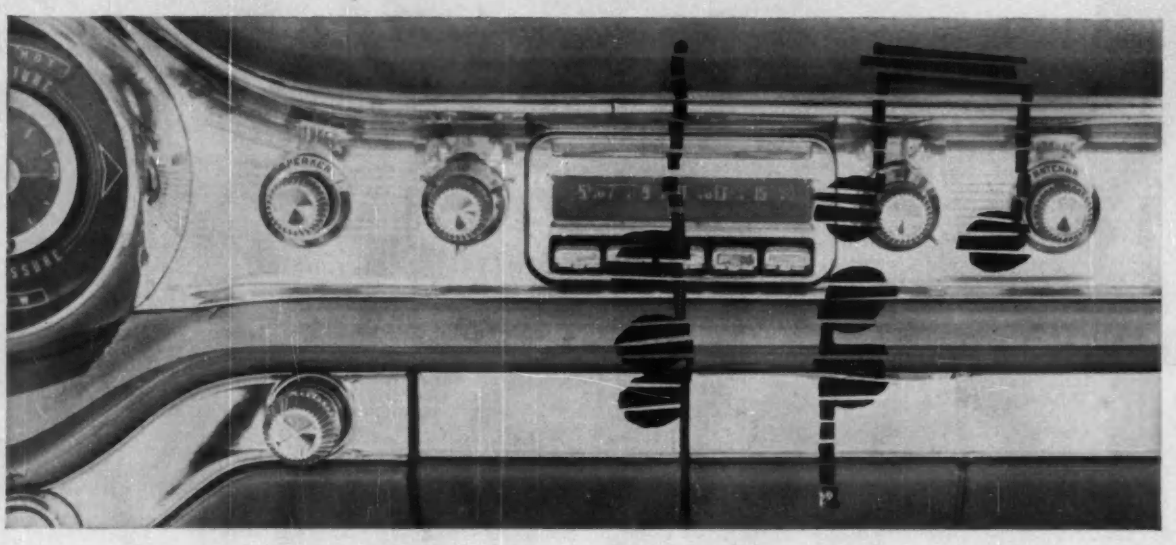
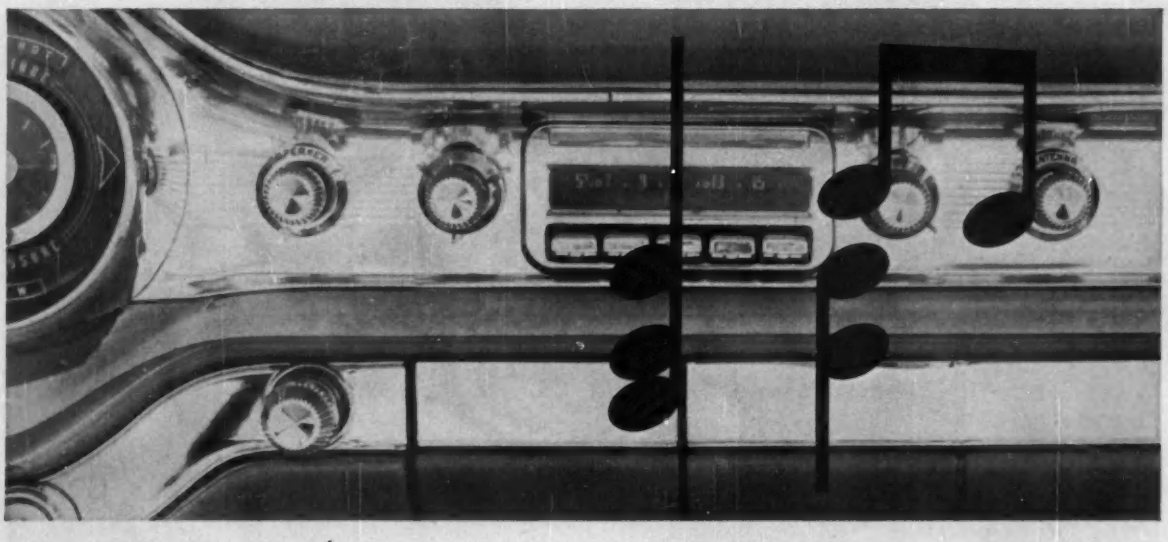


INTERFERENCE / *caused by ordinary cable*



ELIMINATED / *with Packard T.V.R.S. cable!*

The annoying interference with radio receivers, created by automotive ignition systems, *was* a real problem. Old attempts to handle it included resistors at the distributor and spark plugs, but they were only a partial answer. Packard Electric engineers developed a special non-metallic conductor designed to distribute suppression evenly throughout the cable. Same sturdy rubber-neoprene insulation, same long life as other Packard cable, *but with better reception for car radios, nearby radio and television sets and 2-way mobile communications systems.* In spite of the benefits enjoyed through the use of T.V.R.S. Ignition Cable, there is no sacrifice of engine performance!

Now, Packard's exclusive T.V.R.S. (Television-Radio-Suppressor) cable is standard equipment on most new cars. The specialized knowledge of Packard engineers who solved that sore problem is at your service to help you design other cost-cutting or service-improving items. Packard Electric maintains offices in Detroit, Chicago, and Oakland, California for your convenience.

Packard Electric

Warren, Ohio GM GENERAL MOTORS

"Live Wire" division of General Motors

valve gear for any engine

Hydraulic and Mechanical Tappets (Barrel or Mushroom Type) of Alloy Steel, Hardened Alloy Cast Iron, Chilled Iron, or Alloy Chilled Iron • Push Rods • Adjusting Screws • Retainers

No matter what your valve gear requirements, it will pay you to check with Chicago's Tappet Division. For here you get the benefits of specialized techniques and facilities which, in 25 years of producing tappets and other valve gear, have established long records of trouble-free service . . . verified in over 25 million engines.

Chicago's special staff of tappet engineers can provide complete valve train designs for all types of engines . . . car, truck, tractor, diesel . . . aircraft, outboard, power mower, or industrial.

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Whatever your valve gear problem, just call Chicago's tappet engineers today. You will find it advantageous to contact Chicago *while you are still in the preliminary design stages.*

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DIVISION OF STANDARD SCREW COMPANY • ESTABLISHED 1872

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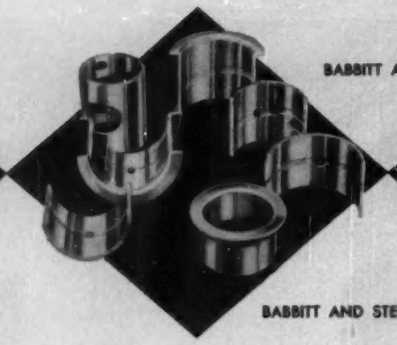

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You can count on getting the correct sleeve bearing for each application, when you specify Johnson Bronze. Competent engineers and metallurgists, backed by more than 50 years exclusive bearing experience, are available to help you solve your bearing problems. They will recommend the most economical and efficient bearing for each application. All types of sleeve bearings, either standard stock sizes or made to specifications, are available without delay. To get the exact bearing you need at the most economical price, call, write, or wire Johnson Bronze Company, 675 South Mill Street, New Castle, Pennsylvania.

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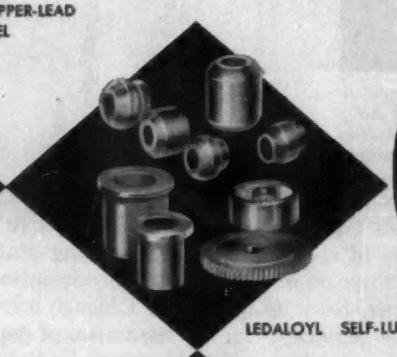

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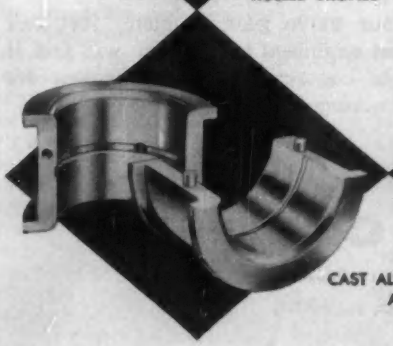
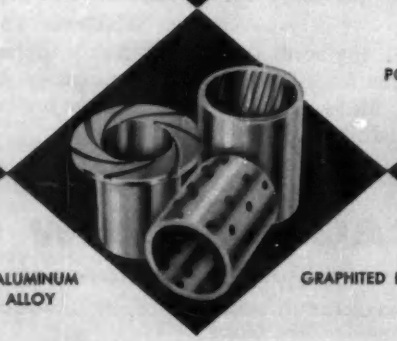


CAST ALUMINUM ALLOY



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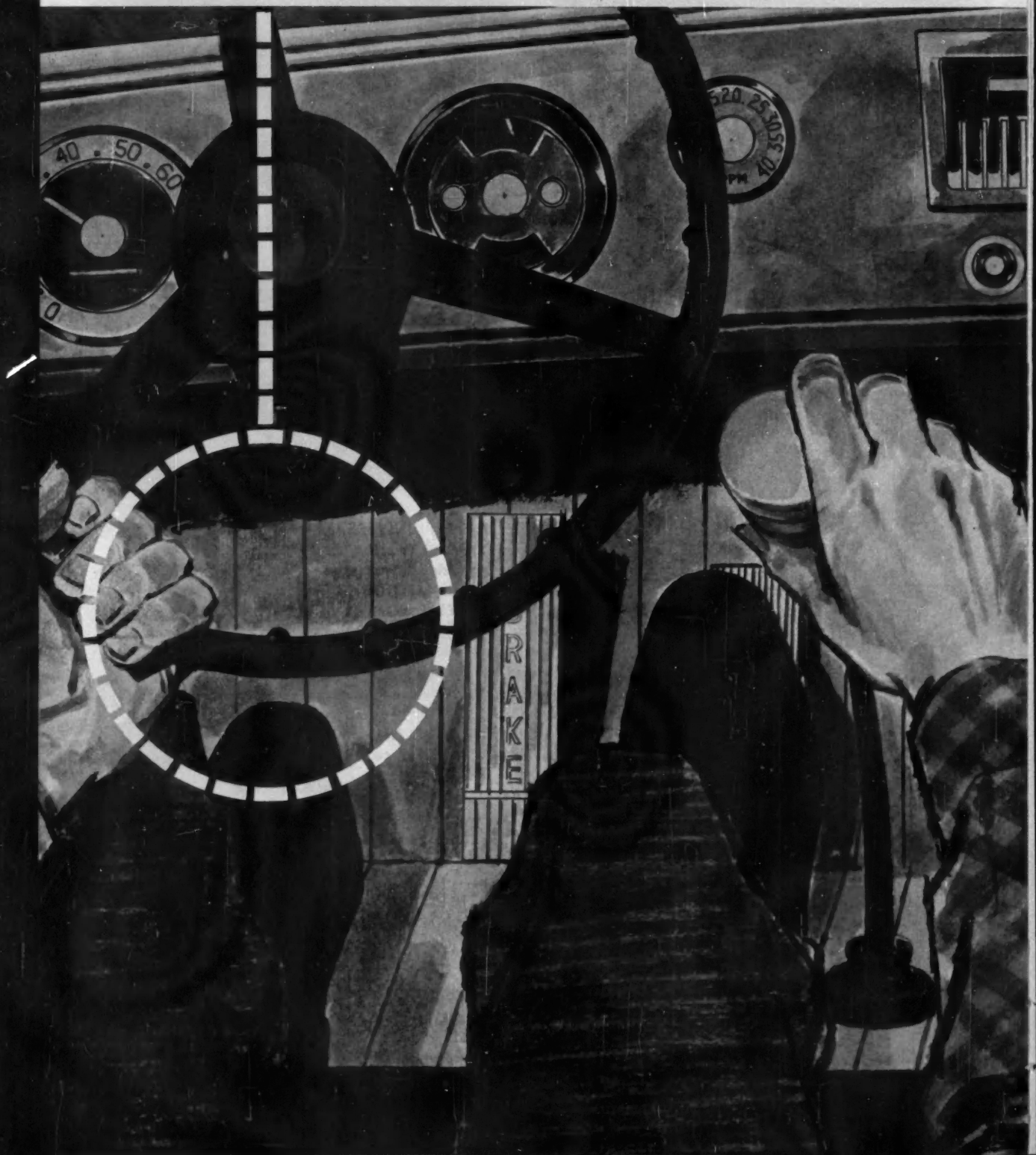
the clutch is in but the pedal's out... it's

Spicer's New Presto-



matic* Transmission

. . . with the touch-button control that takes the effort out of driving.

Here's the Semi-Automatic Truck Transmission that's Got Everything. . . Yet its Cost is the Lowest!

No clutch pedal . . . it's been replaced by a simple touch-button switch on top of the shift control lever. Touch the gearshift knob and the clutch is disengaged . . . automatically!

Smooth engagement from a standing start . . . without using a clutch pedal . . . because the Presto-matic Transmission automatically engages as the driver presses the accelerator.

Automatic clutch throw-out when the engine returns to idling speed. The driver can inch along in heavy traffic just as he would with a fully automatic transmission.

Lowest initial cost . . . absolutely the lowest . . . of any semi-automatic transmission system on the market.

Maximum fuel economy found only in a transmission-clutch system. And, the driver controls the gear he's in for top fuel economy in every situation.

Minimum maintenance because there are no moving parts or adjustments to be made in the automatic control mechanism. Clutch life is greatly increased since the driver can't overspeed the engine when engaging the clutch.

Maximum durability achieved through selection of simple components that have been time-tested and proved as a complete, tailored assembly.

Greater safety for the driver and his equipment because the Presto-matic Transmission leaves gear selection in the hands of the driver at all times.

Simplifies chassis design by eliminating many of the remote control linkage problems found in Cab-Over-Engine or Tilt-Cab installations.

Write now for a free illustrated booklet containing complete information on the operational advantage of the remarkable NEW PRESTO-MATIC TRANSMISSION. The address is Dana Corporation, Toledo 1, Ohio.

DANA Spicer

DANA CORPORATION

TOLEDO 1, OHIO

*Patent Pending

For Freon 12 Hose Assemblies

Depend on ANCHOR Specialized Experience

Anchor Freon Hose Assemblies are products of specialized engineering, supported by an intimate knowledge of field practices and requirements. This, together with Anchor's "Accent on Accuracy" in manufacture is the reason why Anchor Freon Hose Assemblies are a standard for both automotive and industrial applications where Freon 12 is used. They are furnished in standard assembly with rayon braid or one wire braid hose. Also available are assemblies which combine the standard rayon braid or one wire braid hose assemblies with bent tube as an added economy feature. These are designed to your specifications. To insure the longest, leakproof service of your Freon hose installations, you will profit by standardizing on Anchor Assemblies. Write for Catalog No. 601.

Power Steering

Andy Anchor says: Ask for Catalog No. 601

Typical Anchor Hydraulic and Power Steering Hose Assemblies are also illustrated and described in Catalog No. 601.

Easier to Connect or Disconnect!

ANCHOR **FLANCO**®

SAE 4-Bolt Split-Flange Unit and "O" Ring Flange Head Couplings!

1. Just loosen the bolts —
2. Remove ONLY ONE —
3. Pivot the Split-Flange Clamp Half, together with the "O" Ring Flange Head Coupling, around the other bolt.
4. Remove Hose Coupling!

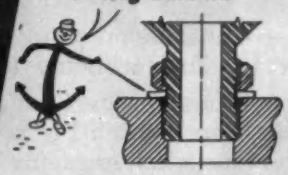
- Eliminates costly pipe threading operations, separate union and swivel connections.
- No threads to wear or tapered seats to groove.
- Disconnect hose lines and reconnect many times without damage, or leaks.
- Flanco "O" Ring Flange Head Type Couplings are available in Pressed-On or Reusable Clamp Type, as well as Weld Type Fittings.

Write for Catalog 402

NOW an IMPROVED and BROADER LINE of ANCHOR

SAE STRAIGHT THREAD "O" RING BOSS FITTINGS

"This NEW Back Up Washer eliminates "O" Ring extrusion"



Today, Anchor is offering not only a more extensive line of SAE Straight Thread "O" Ring Boss Adapters, but one that is also greatly improved.

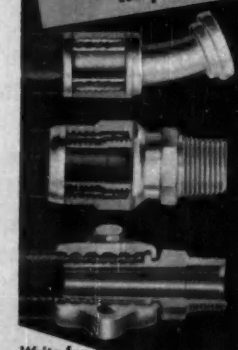
These fittings are now equipped with a factory installed, Back Up Washer that eliminates any possibility of "O" Ring extrusion.

An even greater selection of standard sizes is now available in Anchor's already comprehensive line.

Anchor's new Catalog No. 204, describes the broader line of SAE Straight Thread "O" Ring Fittings and the complete line of Standard Adapter Unions and Pipe Fittings. Write for it today!

WRITE FOR NEW ANCHOR CATALOG 204

This Inside Story— why ANCHOR® HOSE ASSEMBLIES Meet Your Most Rigid Requirements



The "inside story" refers first to the cross-sections shown from which the advantages of Anchor Hydraulic Hose Assemblies can be learned.

But, beyond these obvious benefits, we refer to the intangible advantages evolving from the years of experience in production of hydraulic hose assemblies—advantages that show up only in bonus months of dependable service.

Anchor Hydraulic Hose Assemblies are made for high, medium and low pressure service and for use on virtually any equipment using a hydraulic system. Working pressures range from 100 PSI (2" I.D. Spiral Wire Hose) to 7000 PSI (¼" I.D. 3 Wire Braid Hose) and a variety of coupling styles are available.

Write for Anchor Catalog No. 575 with specifications on Anchor's very complete line of hose assemblies.

ANCHOR COUPLING CO. INC.

334 North Fourth Street, Libertyville, Illinois
Branch Offices: Dallas, Tex., Plymouth, Mich.

See Hydraulic Flanged Tube, Pipe and Hose "O" Ring Connection Standards on Page 587 in 1959 SAE Handbook.

See SAE Standards for Boss Type Fittings on Page 571 in 1959 SAE Handbook.

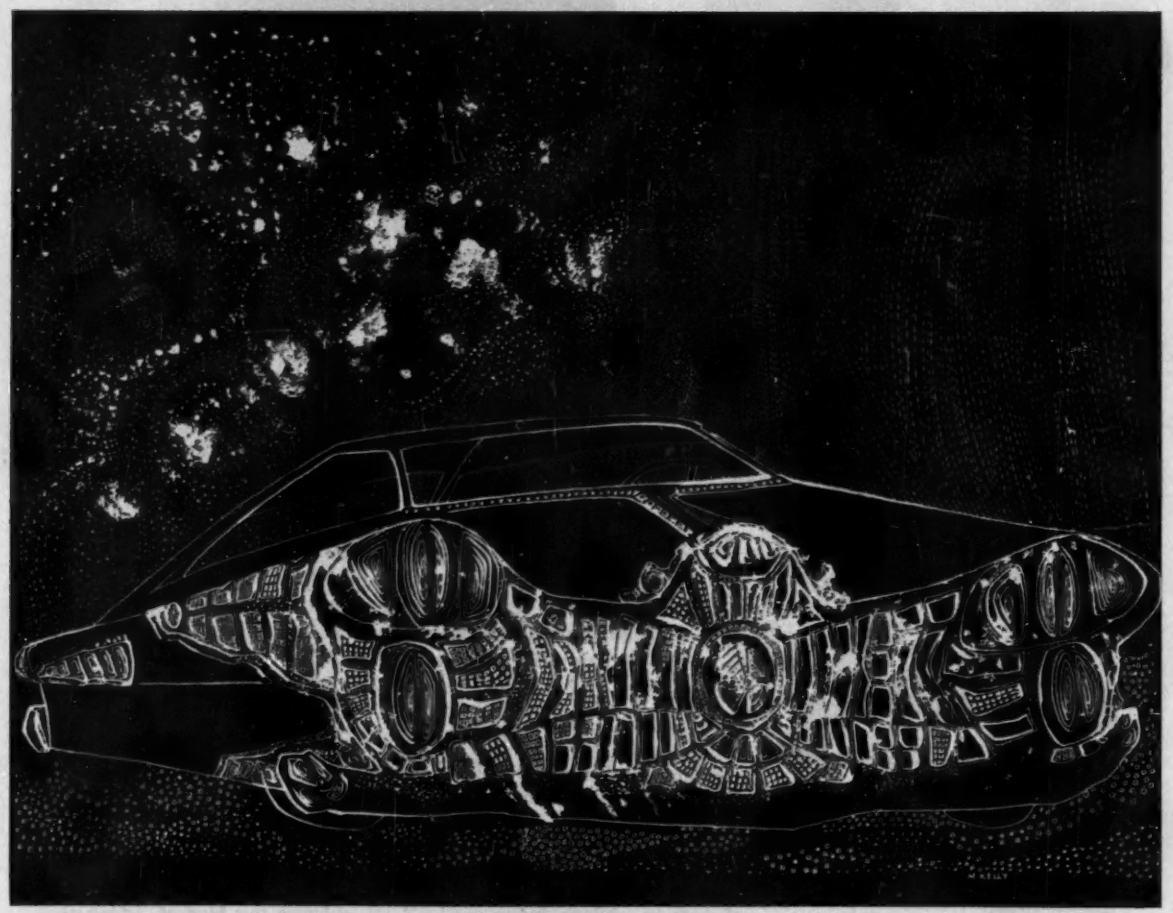
nightmare alley

If a car could dream, what stuff would its nightmares be made of? Untranquilized, tossing feverishly in its carport, it would fall prey to that ramshackle specter that haunts all denizens of the road. From its mechanical libido would emerge boogermen built of road salt, sea air, sand storms and freeze . . . enough to frighten any motor car right out of its trim.

Save that tender, quaking soul! Insure Valhalla by prescribing a liberal dose of Stainless Steel to last a lifetime . . . and to last without the bother of pads, polishes or protective fluids.

Actually, you'll be doing yourself a favor because Stainless Steel has sales appeal! Trim your new model with copious quantities of Stainless Steel and *tell* your customer about it. He already knows what a miracle metal Stainless is, but may not know that there is any on your car. As for yourself, you're surely aware that Stainless Steel trim often costs less than other materials because there are fewer fabricating steps, you can use thinner gages because it is so strong, and there is no need to overdesign to allow for corrosion or impact damage.

USS is a registered trademark



United States Steel Corporation—Pittsburgh
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United States Steel Supply—Steel Service Centers
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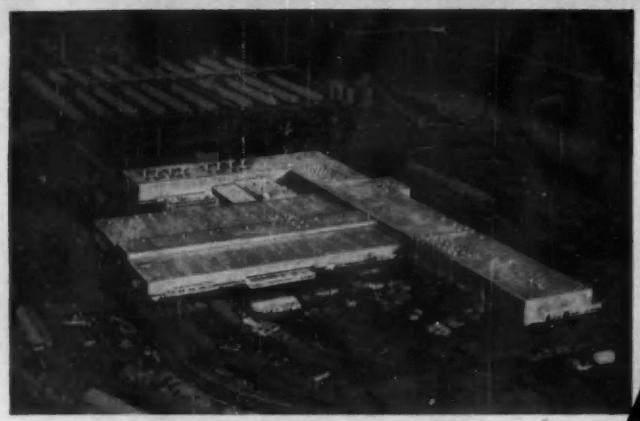
USS **United States Steel**



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Olin Aluminum's new fully integrated facilities assure you a dependable supply of primary aluminum for expanding uses. From this new source will come the finest alloy ingot for foundry uses.

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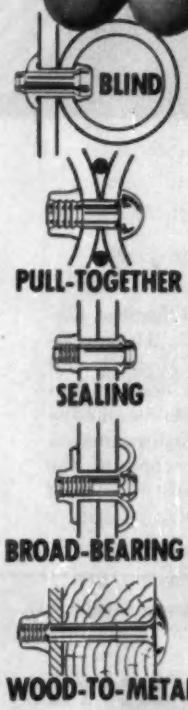

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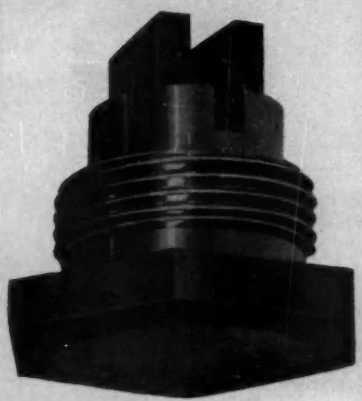

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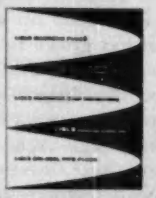
Engines, pumps, gear cases, transmissions and hydraulic systems all benefit when Lisle Magnetic Plugs are used. They remove razor-sharp abrasive bits of metal — preventing them from scoring and pitting raceways, bearings, cylinder walls and other critical parts and surfaces.

A powerful, permanent magnet pulls out and holds the harmful ferrous particles present in the circulating lubricant.

Hundreds of different Lisle plugs are kept in stock for all types of applications.



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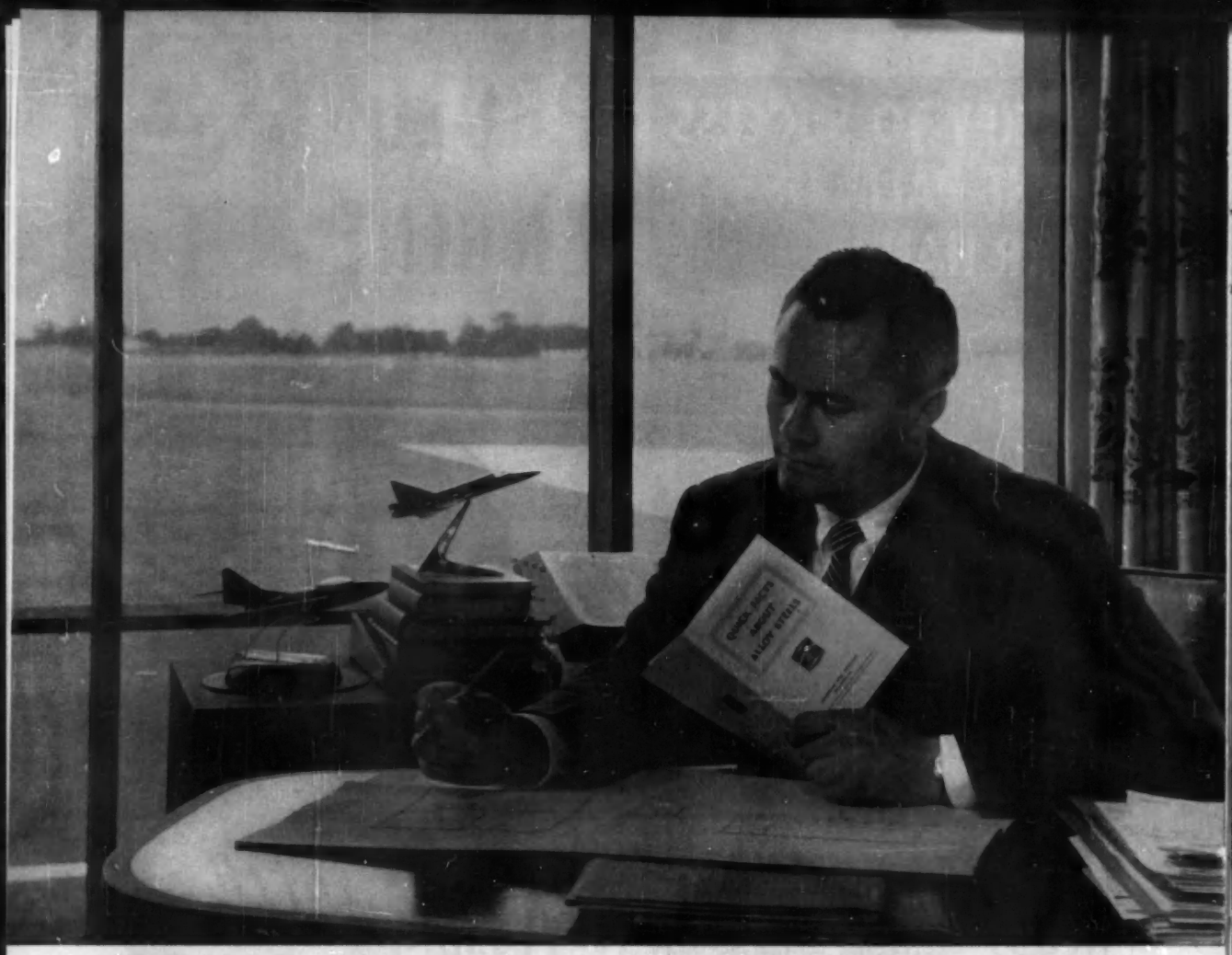
Sample plugs for testing will also be sent free upon request.

LISLE
CORPORATION
Clarinda, Iowa

Attention SAE Member Planning to Attend the Engineering Display at Hotel Sheraton-Cadillac December 12–16 in Detroit: We'll be at Booth 53. Stop in and visit.



The little booklet on alloy steels that grew into a textbook . . .

Quick Facts about Alloy Steels appeared for the first time in 1956, as a collection of reprints of a series of Bethlehem advertisements in metalworking magazines.

The small booklet was well received, and we kept adding more of the informative advertisements as we reprinted it to keep up with demand. Today, it has grown to 40-page size, and is in its Third Edition. More than 20,000 booklets have been distributed at the written request of executives, engineers, designers, and others, who have found *Quick Facts* to be an authoritative small textbook on the fundamentals of alloy steels. Here's what a U. S. Navy engineer wrote:

"*Quick Facts* is a small textbook of information—a booklet that has been needed for a long time. One of my associates and I had a metallurgical problem involving alloy steels. We just didn't have the information. A friend showed me a copy of your booklet *Quick Facts*, and there on one page, under the subject 'Determining Depth Hardness,' was just what we wanted to know!"

The current booklet contains reprints of the complete series of advertisements, on such subjects as, "What is an Alloy Steel?" "Effects of Elements," "Grain Size," "Heat-treatment," "Quenching Media," and others. It's written in concise, layman's language, from data compiled by Bethlehem's metallurgical engineers.

Would you like a copy of the *Quick Facts* booklet? Just fill out and send in the coupon.

PUBLICATIONS DEPARTMENT, ROOM 1030
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Please send me your "Quick Facts about Alloy Steels" booklet.

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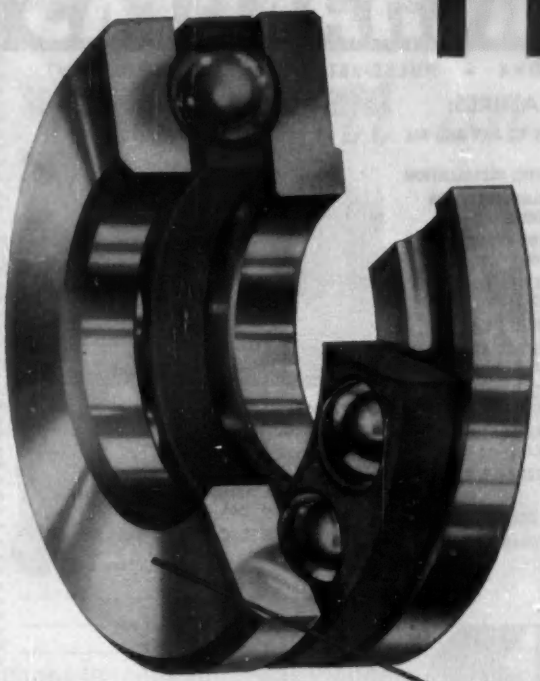
BETHLEHEM STEEL

BETHLEHEM STEEL

PRECISION



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Finish to 5 micro inches

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Parallelism to .0001″

Concentricity to .0002″

Squareness to .0003″

Aetna Bearing Precision is as close to perfection as it is possible to achieve with advanced production methods, extremely accurate precision equipment, constant inspection-checking with special fine-measurement gages, and the integrity of a skilled, experienced personnel.

Each individual process in the entire production procedure is checked and inspected for exact conformity to absolute pre-determined specifications from the receipt of raw material through to completion and final assembly—then checked and inspected again as a completed unit for accuracy, smoothness and operating efficiency.

The result is longer service life—greater ease of installation—and continued, smooth-running anti-friction performance. *You have a better operating product when it is equipped with Aetna Bearings.*

Illustrated is the Optical Flat—only one of the many exceedingly precise instruments which insure the maintenance of these exacting precision standards.

PRECISION PARTS

held to the same exacting standards, produced in quantity at low cost to your exact specifications. Sizes up to 38″ O.D. Surface finishes, parallelism and structural characteristics as specified.

You are invited to submit blueprints, quantities and delivery requirements for quotation.

AETNA BALL AND ROLLER BEARING COMPANY

Aetna

DIVISION OF PARKERSBURG-AETNA CORPORATION • 4600 SCHUBERT AVE. • CHICAGO 39, ILL.
In Detroit: SAM T. KELLER, 1212 Fisher Bldg.
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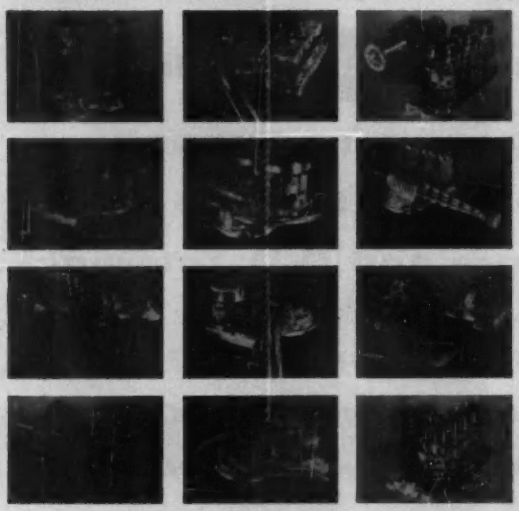

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65% BOOST; 107 HP INCREASE
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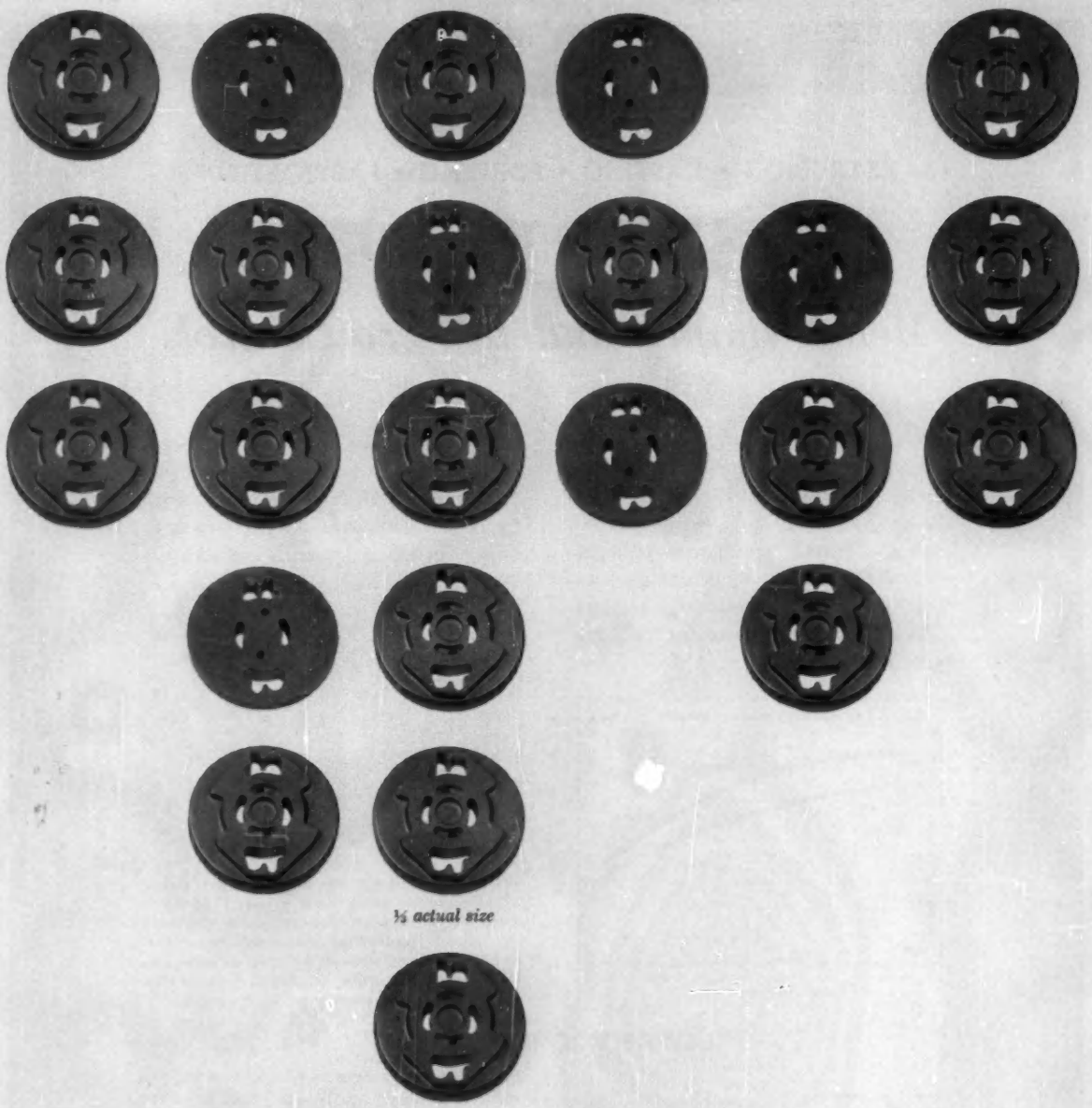

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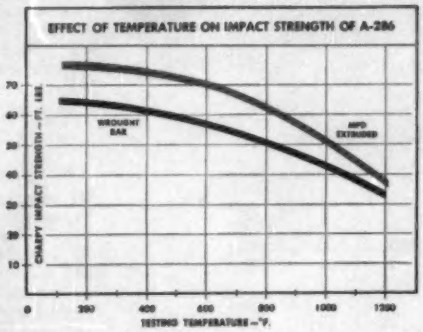
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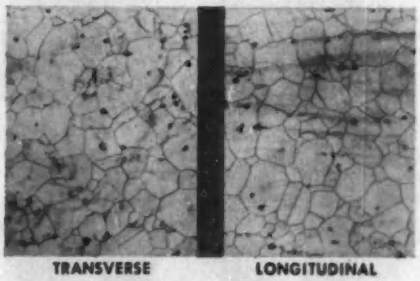

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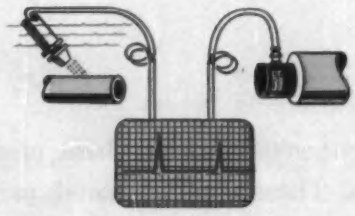

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